DETERMINING PRODUCTION CAPABILITY IN AIRCRAFT MAINTENANCE: A REGRESSION ANALYSIS

THESIS

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The views expressed in this thesis are those of the authors and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

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THESIS

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Preface

Production capability measurement in aircraft maintenance is difficult and presently there is not a method of assessing an aircraft organization's "portrait" of production capability. Many performance measurement indicators exist that give maintenance managers a general assessment of organizational performance but cannot accurately predict sortie production based on maintenance system capability.

HQ SAC provided twenty-one months of ex post facto data for nine command aircraft systems. The data included twenty-three maintenance constraint independent variables and three production output dependent variables. The production output measures included Mission Capable Rate, Total Not Mission Capable Supply Rate, and Total Not Mission Capable Maintenance Rate. Correlation analysis and stepwise regression were used to build three regression models for each aircraft type to identify maintenance constraints that predict production capability.

I thank Jesus Christ my Lord for the strength and Divine Wisdom to keep priorities ordered that He and my family stayed my focus throughout the thesis research. I thank my children Elizabeth, Matthew and our preborn son for their patience and understanding when daddy had to go to his room. To my beautiful wife whose love, support and friendship encouraged me to continue when I wanted to quit; I love you. Finally, I thank Lt Col Phil Miller, my thesis advisor, who gave me direction when I exited the road to successful thesis completion, and through his knowledge and experience kept me focused on the goal; graduation.

Charles R. Jung

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Abstract

This research analyzed twenty-three maintenance constraint and three production output performance measures for nine SAC aircraft systems. SAS System for Elementary Statistical Analysis is used to analyze twenty-one months of ex post facto maintenance data. Correlation analysis is used to identify maintenance constraints that assist in explaining aircraft maintenance production capability. Forward stepwise regression is used to build predictive models of maintenance production capability for each of the nine aircraft systems. The twenty-three maintenance constraint measures are regressed against three productivity output measures: Mission Capable Rate, Total Not Mission Capable Supply Rate and Total Not Mission Capable Maintenance Rate. The regression models and validation results indicate regression models selection of maintenance constraints is not consistent between aircraft and prediction accuracy is erratic. The findings indicate performance measures may not be generalizable across all aircraft and key performance measures for one aircraft may not be important for another. Production capability assessment based on a few productivity measures generalized across all aircraft types may lead maintenance managers to formulate wrong conclusions about maintenance performance and capability. The validity of these findings is limited by the relatively small number of observations for each aircraft.

DETERMINING PRODUCTION CAPABILITY

IN AIRCRAFT MAINTENANCE: A REGRESSION ANALYSIS

I. Introduction

General Issue

Aircraft maintenance is an expensive business. The investment of money, manpower, equipment, spare parts, facilities and other resources, make it the single largest facet of logistics in the Air Force (21:8-1). The current world situation will not help the future management of this expensive logistics element. The House Armed Services Committee Chairman Les Aspen (D-Wis.) had these words to say about the decline of communism in eastern block countries and the impact on defense spending:

> We have entered the Gorbachev era. The deficit will continue to place severe constraints on all spending, of course. But the next defense budget will be Gorbachev-driven . . . and you can bet that the impact [of events in the East] will not generate support for increasing defense budgets. (4:28)

In contrast, the Senate Armed Services Committee Chairman Sam Nunn (D-Ga.) attributed need for defense budget cuts to fiscal constraints driven by deficit spending. Senator Nunn had the following to say about defense spending:

> I believe [the reductions are] fiscal cuts rather than threat-related cuts. The threat has certainly gone down in Europe, and that makes the background music more accommodating and soothing to the body politic for these cuts. But even if the threat had not gone down, if the Administration [were to] have any chance whatsoever of meeting the Gramm-Rudman target next year, they would have had to make cuts of this magnitude. (4:28)

Though Eastern Europe appears to be disarming and attempting to build friendly relationships with the West, as seen in the reunification of Germany, the Middle East has threatened the peace of the United States. The occupation and annexation of Kuwait by President Saddam Hussein and Iraqi military forces and subsequent war with the United States and allied powers may have a civilizing effect on the radical defense cuts called for by those wanting to cash in on the "peace dividend." Gregory Copley states:

> So we saw the complacency of the world power blocs - NATO-aligned, the Warsaw Pact-aligned, and the Non-Aligned - change first to a euphoria as the era of glasnost, perestroyka and 'global peace' emerged. Now we have seen Saddam Hussein shake that euphoria and return many politicians to a semblance of reality. (3:26)

Whether or not the war for Kuwait in the Middle East quiets the call for cashing in the "peace dividends" at the expense of the Department of Defense budgets will only be known as history runs its course. At least for the near future, the congressional cuts are a reality the defense manager will have to deal with.

It makes little difference whether the current defense budget cuts are driven by a perceived outbreak of "global peace" or fiscal constraints resulting from the federal deficit. The rational for the defense spending cuts is transparent to the aircraft maintenance manager. Regardless of the reasons, maintenance managers will have a tougher road ahead. The restricted operating budgets resulting from deep congressional spending cuts will dramatically change the way maintenance managers do business. For the aircraft maintenance manager, congressional defense spending cuts may mean lower manpower levels, fewer spare parts and decreased operating budgets. These congressional

spending cuts coupled with an increasing need in the growing operations community for training is certain to tax the maintenance manager's skill and wisdom in managing maintenance resources. Identifying the "Portrait" (estimation) of production capability is critical, so that maintenance managers can make smart decisions when planning and allocating limited maintenance resources for sortie production.

Problem Statement

Existing production capability measurements in aircraft maintenance fail to give Strategic Air Command (SAC) maintenance managers an accurate estimation of maintenance production capability when planning maintenance support for sortie generation.

Research Questions

1) What are the existing measures of aircraft maintenance production capability in SAC?

2) What are the aircraft maintenance production constraints that limit or enhance production capability?

3) What are the statistical relationships between the maintenance constraints and an organization's production capability?

4) What maintenance constraints can be used in a predictive model of a maintenance organization's sortie producing capability?

Scope of the Research

The scope of this research project will be limited to SAC aircraft maintenance. The research will be further limited to SAC wing organizations flying the KC-135A/D/E/Q, KC-135R, RC-135V/N, E-4B, B-1B, EC-135A/C/G/L/N/Y, B-52H, B-52G and FB-111A aircraft. The results of

this research may not apply to other aircraft types in SAC or other major commands and organizations. The regression model prediction range will be confined to the established range set by the ex post facto data used to build the model. Extrapolation outside of the data set will make the prediction invalid.

HQ SAC/LGY will provide the maintenance summary data for the aircraft types under study. The data elements will cover twenty-one one month periods of historic data.

Background

Estimating aircraft maintenance production capability is difficult. The difficulty is due in part to a lack of understanding of how aircraft maintenance constraints correlate with each other and act upon production output. Capt Bill Gilliland submitted a masters thesis to the Air Force Institute of Technology School of Systems and Logistics which reported correlations between maintenance productivity measures in the Military Airlift Command (MAC). Capt Gilliland's research identified productivity measures listed in Table 1 as inputs and outputs of MAC aircraft maintenance. The statistical analysis of these productivity measures spawned the following conclusion:

> Of the thirteen measures evaluated, eight produced the strongest explainable model reflecting maintenance productivity. Manhours per flying hour was the predominant output when viewed as a result of the influence of mission capable rates and maintenance scheduling effectiveness. Cannibalization rates, delayed discrepancies (both awaiting parts and awaiting maintenance) and the average number of possessed aircraft were the inputs which appeared to contribute most significantly to mission capable rates and maintenance scheduling effectiveness. By understanding the relationships among these measures and monitoring their interaction, a manager may be better able to positively influence a maintenance unit's productivity. (8:110)

TABLE 1

MAC MAINTENANCE PRODUCTION VARIABLES

OUTPUT

Nomenclature	Variable Name
labor hour/flying hour	msr 1
mission capable rate	msr 2
repeat/reoccurring discrepancies	msr 7
maintenance scheduling effectiveness	msr 8
maintenance air aborts	msr 9
homestation reliability	msr 10
enroute reliability	msr 11
training reliability	msr 12

INPUT

Nomenclature	Variable Name
cannibalization	msr 3
awaiting maintenance discrepancies	msr 4
awaiting parts discrepancies	msr 5
average possessed aircraft	msr 6
base self sufficiency	msr 13

(8:94)

This thesis will accomplish one of Capt Gilliland's research recommendations. The recommendation called for a continuation of the same methodology applied to different major commands using a data set

larger than six months. The purpose of this type of research is to further validate the original findings (8:115-116).

This thesis will follow through with variations of the research recommendation. SAC will be the major command of interest for this thesis and will use a twenty-one month data set. Statistical analysis of productivity measures will be by aircraft model.

Summary

This introductory chapter identified the current congressional attitude towards defense spending and the challenges defense spending cuts will provide for the aircraft maintenance manager. This chapter also identified the problem statement, research questions, scope of research and background information.

The Literature Review in Chapter II will first identify theories of productivity measurement and ratios used to measure productivity in business and the Department of Defense (DOD). Second, principles of forecasting will be explored looking for applicability to aircraft maintenance production management. Third, analysis of existing theses will discuss previous findings of research done to identify maintenance constraints that act on production output.

II. Literature Review

Introduction

The purpose of this literature review is to give the reader a working knowledge of the management disciplines needed to assist in understanding this thesis. Additionally, the literature review will equip the researcher with the necessary tools with which to conduct the research. The literature review will examine two management disciplines as they relate to determining production capability in aircraft maintenance. The two disciplines to be discussed are productivity measurement and forecasting principles as they apply to understanding and explaining the interaction between production process inputs, as determinants of production capability, and process outputs. The third literature topic area will be an analysis of existing theses to identify maintenance constraints that act on production output.

The productivity measurement literature is organized by subject with salient information discussed for each productivity measurement concept. The concepts are presented in the following order: productivity measurement defined; inputs, outputs and ratios; macro and micro measurements; productivity measurement in the Department of Defense (DOD); and the productivity measures used in the Strategic Air Command (SAC). This section will lay a foundation in productivity by first establishing what productivity measurement is and then explaining its concepts and organizational levels of application.

Forecasting principles are discussed with a concentration on understanding why regression analysis is chosen for this research

project. Assumptions and limitations of different forecasting techniques will also be presented.

A literature review examining theses accomplished in previous years that studied the effect of maintenance constraints on production capability is also presented. The research projects are presented by thesis discussing findings and conclusions. The emphasis of the research review is to find out what correlations previous research has uncovered between maintenance constraints and productivity outputs.

Productivity Measurement

If an organization is to manage productivity, meaningful and accurate productivity measurement ratios must be formulated at all levels in the organization.

> Lord Kelvin wrote, 'When you can measure what you are speaking about and express it in numbers, you know something about it; but when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter be.' If the matter be productivity it necessitates the use of two numerical measures - output and input." (12:127)

An organization cannot know if it's achieving acceptable productivity performance without establishing meaningful objective measures. Managers cannot hold people accountable to a level of productivity performance if the performance cannot be quantifiably and reliably measured; they cannot manage what they do not measure (12:128-129).

Productivity Measurement Defined. There is no generally-agreed-upon definition of productivity measurement. "Productivity means many things to many people" (18:10). There are as many different productivity measurement ratios as there are types and levels of

organization. In a production organization, each process' and plant's hierarchial level requires a different productivity measure to accurately appraise performance (18:10).

> Individual firms need a comprehensive system of productivity measurements at the firm, plant and process level that will enable them to know how they are doing, help them to spot weak areas, and help them know what to do to achieve productivity increases. (17:8)

It is important that the organization formulate measures at each activity level, and that the measures accurately reflect the relationship between the activities' outputs and inputs of business. "Measurement of productivity must be appropriate to the problem at hand" (18:10).

Productivity measurement definitions vary in complexity. In its basic form, productivity is a ratio, also called an index, that measures outputs against inputs. "Most productivity measures begin with the same simplistic concept: output per unit of input" (15:37). A productivity measurement ratio is a representation of physical inputs and outputs (2:111):

$$\text{Productivity} = \frac{\text{Units of Output}}{\text{Units of Input}} \tag{1}$$

This simple ratio is the standard form of the productivity equation.

A more complete definition is "a measure of the efficiency with which resources are used in the production of goods and services" (15:37). In this definition, resources are inputs and goods and services are outputs. The definition embraces the concept of measuring a production system's efficient operation as the measurement objective.

A moderately complex definition addresses dimensions of activity neglected in the other two definitions:

> Productivity is a measure of production efficiency. Here, we use the word 'production' in a broad sense and define it as an activity which converts a basket of goods and services (inputs) into another basket of goods and services (outputs). Productivity measures the efficiency with which a production activity converts inputs to outputs. Ideally, productivity should measure the efficiency in terms of input and output utilities since a production activity is intended to create utility. (1:29-30)

Productivity measures cannot ignore the dimensions of the process environment and remain meaningful and accurate. Ignoring the productivity factors in the following measurement model will make the ratio meaningless. The form of the productivity model is (1:31):

$$\text{Productivity} = \frac{\begin{array}{l}\text{The Sum of all (Output Quantity in Time}\\ \text{Period t in the Original Denomination) X}\\ \text{(Output Conversion Factor) as an Element}\\ \text{of all Output Indices.}\end{array}}{\begin{array}{l}\text{The Sum of all (Input Quantity in Time}\\ \text{Period t in the Original Denomination) X}\\ \text{(Input Conversion Factor) as an Element}\\ \text{of all Input Indices.}\end{array}} \qquad (2)$$

This definition includes the concepts of providing utility to the consumer, accounting for output and input original denominations (man-hours, pounds, machine hours, dollars, etc.), using conversion factors to transform inputs and outputs to common denominations, and time-series measurements (productivity ratio in one period compared with the same ratio in another period) and cross sectional measurements (comparison of one productivity ratio in a period with a ratio for a similar activity in the same period) when defining productivity (1:29-31).

Inputs, Outputs and Ratios. Although definitions of productivity measurement vary in complexity, all measures are defined as outputs against inputs in the form of ratios. In the open systems model of an organization, resource inputs are fed into a process that transforms the resource inputs into a goods or service output of value to the consumer. The open system exchanges goods and services with other systems in the environment. Inputs of one system are one or more outputs of another system, and outputs of the same system are the inputs to one or more other systems (11:32). The productivity ratio should accurately measure the system's process efficiency at transforming the inputs into valued outputs.

The system's process inputs and outputs can be grouped into separate broad categories. These input categories are defined as follows (1:35-39):

1. Labor inputs are the human resources used in converting resources into goods and services.

2. Government inputs are the goods and services provided by the local, state and federal governments. These goods and services can be fire and police protection, highways, public schools, and national defense.

3. Capital inputs are the equipment and facilities used in the transformation process.

4. Intermediate inputs are the in-process goods and services provided by other production activities.

The production output categories are defined as follows:

1. Goods for external use are the products that will be consumed by the user.

2. Goods for internal use are products used as inputs in the same production process at a future time; for example, General Motors manufactures radios that are installed in assembly line automobiles.

The output and input measures are formulated into ratios used to measure the production process efficiency. Five types of ratio models were developed by aerospace managers from the National Aeronautics and Space Administration (NASA). The ratios with aircraft maintenance examples are as follows (11:29-32):

1. Effectiveness = Projected / actual : number of sorties scheduled against number actually flown.

2. Quantity = Process or product unit / sources of cost : number of maintenance shop pieces produced against man-hours consumed.

3. Quality = Indicators of error or loss / process or production unit : total errors found in aircraft forms against total number of entries.

4. Value = Desirability / sources of cost : measured customer satisfaction with morale programs against the cost to provide morale and welfare services.

5. Change or improvement = Performance measure period two / Performance measure period one : measure the change in sortie rate of this quarter against last quarter.

It is important to remember that productivity measures must not be just percentage ratios. Historically, management has given only minimum attention to productivity due to the absence of linking productivity measures to the bottom line of cost and profitability. Management may give more attention to productivity measures if they are linked to the business bottom-line performance measure (5:63-70).

Macro and Micro Measurements. Productivity measures are categorized and applied at two organization hierarchial levels: the firm or organizational level and the department or cost center level. The firm or organizational level measure is called a variety of names, including macro (17:8), global (7:52), aggregate (15:37-38), and total (1:31) productivity measure. When the ratio includes all the firm's or organization's inputs in the ratio denominator then the measure is referred to as total productivity measurement (1:31).

> Aggregate productivity measures are designed to evaluate the performance of a large collective body (a plant, division, company or an industry) over an extended time frame. An aggregate productivity measurement system can provide management with essential indicators of the effective use of all component resources. (15:37-38)

John Kendricks, the economist, developed the concept of total productivity measurement in the early 1960's.

> Essentially, Kendrick's technique is to relate the total output of a firm or industry in real terms to the total inputs used to produce that output. The macro measure is the only comprehensive measure of productivity change for the total enterprise. (17:8-10)

The department or cost center productivity measure is called the micro (17:8), local (7:52), component (15:37-38), and partial (1:31) productivity measure. Micro measures are detailed, but they cannot be aggregated into the overall productivity measure of a firm. Micro measures are measures of efficiency rather than productivity. They will measure a unit's optimization but cannot be used to measure total unit productivity. Micro measures are normally financial cost measures and do not measure contribution of resource inputs (17:10). "Component productivity measures are designed to measure the performance of a single activity or a relatively small organizational unit" (15:37-38).

An example of a micro and macro productivity measure integration is backlog measurement in a U.S. Army maintenance shop. The maintenance shop uses four micro productivity measures: 1) Workload in standard man-hours of work accepted by a maintenance shop but not completed; 2) Available man-hours per day as a measure of how many direct man-hours (labor expended in the production activity adding value to the product or service) and indirect man-hours (labor expended for needs not in direct support of production); 3) Utilization rate as the percentage of labor that is direct labor; and 4) Efficiency rate as a measure of skill level expressed as the standard man-hours to complete a job divided by the actual man-hours to complete the job. The shop uses one macro measure to report backlog performance. Backlog is the aggregate of the four micro measures and represents the work waiting for entry into the shop and not completed (19:14-15).

Macro productivity measures focus on total outputs against total inputs. Micro measures are a single measure of a unit and are a measure of efficiency rather than productivity. Micro and macro measures must be integrated into management reporting as an integral part of the organization's management information system (15:37-38).

Productivity Measurement in the DOD. Productivity measurement guidance in the DOD is general and does not dictate productivity measures to be used by DOD departments and agencies. A previous thesis reviewed government documents that establishes productivity management in the DOD, the Air Force, and MAC. Also, the research included interviews with maintenance personnel at MAC airlift wings to identify productivity measures in use at the wing organizational level (8:78-79).

The above stated research found that the federal government uses labor output as the measure of productivity. "The presidential order which serves as the primary guidance for productivity improvement defines productivity as the efficient use of government resources to produce a desired output in the form of goods and services" (8:86). Within the DOD, each major component compiles and submits labor hour data. In the Air Force, aircraft maintenance productivity data is submitted for intermediate and depot maintenance levels by the Air Force Logistics Command to the Air Staff for verification, compilation, and submittal to the Bureau of Labor Statistics. This represents productivity measurement at a macro level (8:86-87).

At the micro level, the Major command is responsible for developing productivity goals and measures and managing their respective productivity programs in accordance with AFR 25-3. According to the comptroller directorate at MAC headquarters, supply cost per flying hour is the productivity measure associated with aircraft maintenance. MACR 66-1, paragraph 4-14 lists productivity measures as:

1. manhour per flying hour
2. cannibalization actions per aircraft
3. awaiting maintenance discrepancies
4. awaiting parts discrepancies
5. maintenance air aborts
6. base self sufficiency
7. high component failures/work hour consumers (high failure aircraft components that consume a relatively higher amount of labor hours than other components)

(8:90-91).

Two productivity measures not cited in MACR 66-1 used by aircraft maintenance units are departure reliability rates and mission capable rates. Operational units are free to establish effectiveness and efficiency measures to manage unit productivity. Operational units use several different productivity measures signifying each unit's relative independence from the major command in defining measures that will aid the unit in achieving organizational goals (8:87-88). A list of measures gathered from the wing maintenance units appears in Appendix G of the original thesis (8:92).

SAC Productivity Measurement. SAC productivity measurement is primarily the responsibility of the aircraft maintenance analysis section on the DCM staff at the wing level and HQ SAC/LGY for the command. The data used for analysis is taken from the Maintenance Data Collection (MDC) system which accumulates maintenance data from AFTO form 349, Maintenance Data Collection Record, or the on-line Core Automated Maintenance System (CAMS). The MDC system includes files of maintenance histories for aircraft and missile systems and their subsystems (6:3-1).

The MDC data is used to measure the efficiency and effectiveness as well as the health of the maintenance organizations and the weapon systems. These productivity measures aid the aircraft maintenance managers in assessing the organization's condition and aids in the managers ability to make accurate and timely decisions. The productivity measures used by SAC headquarters and wing organizations are many and will not be presented in this section but will be presented in Chapter IV and used in correlation and regression analysis.

Summary. This literature review presented multiple definitions of productivity measurement. The definitions began with a basic form of the output to input ratio and ended with a moderately complex definition that accounted for utility, denomination, conversion factors and time-series and cross sectional measurements. A discussion of the inputs, outputs and ratios followed, identifying broad categories for inputs and outputs and ratios developed by aerospace managers. Micro and macro measurement and their differences were presented with an example of army maintenance and its illustration of micro and macro measurement integration. Additionally, DOD productivity measures were presented.

There are many different measures of productivity. The differences are attributed to organizational level and process application. The productivity ratio must explain and accurately measure the production process. Ratio measures must be tied to the business bottom-line of cost and profitability to be useful in managing productivity.

Forecasting

The contemporary manager functions and makes decisions in a complicated ever changing environment. In times past, managers could run businesses by making decisions about corporate operations and competitive markets using only intuition and judgement gained through many years of sometimes difficult experiences. Those days have given way to managers who today depend on decision support systems, computer algorithms and heuristic techniques to optimize every decision to the organization's advantage. Forecasting is not intended to be an end in itself. It is a subset of a decision making process used to clarify the

manager's understanding about the uncertain future and increase the value of the manager's final decision (20:1).

This section of the literature review will examine the two forecasting classifications and the major techniques in one of the classifications (qualitative forecasting will only be treated briefly). An evaluation criteria will be presented that will aid in understanding how to correctly match a forecasting technique to a particular situation. Additionally, each forecasting technique will be contrasted to the other techniques exposing assumptions and limitations. The purpose of this review is to give insight into the rationale for choosing multiple linear regression as the statistical model for this research project.

Classifications. Many forecasting techniques have been developed to aid the manager in predicting future business patterns. Marketing, finance, production, and other management functional areas use these forecasting techniques to either increase profits or reduce costs. These forecasting techniques are generally grouped into two categories: quantitative and qualitative (20:4).

Quantitative forecasting techniques include moving average, exponential smoothing and regression analysis. In these methods, historic data is acted upon by a mathematical approach to predict a future value. There are three reasons quantitative techniques have been popular. First, past experience has shown the quantitative techniques to be accurate. Second, development and integration of computers has made data storage, retrieval and computation required by quantitative techniques extremely easy and efficient. Finally, quantitative forecasting is less costly than qualitative techniques (20:5).

The second forecasting classification is qualitative. As stated in the opening paragraphs, this classification will only be defined and contrasted to quantitative techniques. The qualitative method is examining data looking for a change in historic pattern and making decisions based on an expert's judgement to interpret the pattern changes. The qualitative method is expensive and should only be used in long term situations and those that are critical to the firm (20:5-6).

Selecting a Technique. Matching the technique to the situation is a critical step in applying forecasting. A method of matching the forecasting technique to the management objective has been established to aid the decision maker. This method analyzes the characteristics of the forecasting techniques and uses the analysis as a basis of choosing the most accurate technique for the stated objective. Forecasting technique characteristics are grouped in the following categories:

1. The pattern of the data that can be recognized.
2. The accuracy of the method.
3. The type of the model.
4. The cost of using the method.
5. The lead time for which the method is appropriate.
6. The applicability of the method.

(20:18).

The first criteria that should be considered is the pattern of the data. Historic data displays some kind of underlying pattern that can be identified. Forecasting techniques make explicit assumptions about the pattern of data as to the appropriateness of the technique. The four categories of data patterns are horizontal, trend, seasonal and cyclical (20:19).

The second criteria is the accuracy of the method. Data used in forecasting will exhibit one or more of the four data patterns presented in the preceding discussion. In addition to these patterns, the data will also exhibit some amount of randomness that cannot be attributed to a specific cause. The decision maker should attempt to choose a forecasting technique that minimizes the data random component. The better the technique is at accounting for the random component, the closer the forecasted value will be to the actual value (20:22-24).

The third criteria to be considered is the type of forecasting model. The forecasting model is the same as the technique and is referred to as a model in the sense of the procedures used to describe and predict the forecast. Forecasting models can be categorized in four general groups: time-series, causal or explanatory, statistical and nonstatistical. The time-series technique assumes that the data pattern occurs over a period of time and that the pattern will repeat itself in the future. Thus a future forecast can be predicted based on past time period performance. The time-series forecast is good for predicting future events of the organization's external environment but not so good at predicting the consequence of a manager's decision in the current time period on a future event (20:25).

The second model type is the causal or explanatory model. This model's assumption is that certain variables act on or determine the value of other variables. Generally speaking, the causal model treats data that does not have a time element (20:25-26).

The third model is the statistical model and uses the processes and procedures of statistical analysis to determine data patterns and identify the reliability of the prediction of the forecasts being

developed. Statistical models are more complicated than other forecasting techniques and have not been widely used due to the decision maker's lack of understanding (20:26).

Finally, the fourth forecasting model is the nonstatistical model. These techniques are based heavily in the decision maker's intuition and feelings about what is going on in the forecasting process not using fundamental statistical processes and probability theory. Qualitative forecasting methods are nonstatistical in nature (20:26-17).

The fourth criteria to be considered is the costs of a forecasting technique. Cost considerations are important when comparing forecasting techniques and choosing the technique that best fits the decision maker's purpose. There are three different considerations when analyzing cost: development cost, data storage and acquisition costs, and operating and maintenance costs (20:27). However, these cost considerations are not applicable to this research project and will not be considered here.

Lead time, the fifth criteria, should be considered in the forecasting technique. Lead time addresses the time horizon that the forecasting method is trying to predict. Lead time can be divided into four categories: immediate term (less than one month), short term (one to three months), medium term (less than two years), and long term (more than two years). Some forecasting techniques are accurate for only the immediate and short term time horizons and others are more accurate at the medium and long term time horizons. Matching the technique to the objective time horizon is acutely important in limiting the amount of random error that is generated in the forecast (20:28-29).

The final criteria to be considered is the applicability of the model to management practice. Applicability is concerned with the technical suitability and behavioral aspects of the forecasting model. There are three aspects of applicability that need to be considered. These aspects include the time the forecasting method takes to develop, the ease at which the manager can understand the technical properties of the technique and interpret the results, and the manager's depth of understanding and confidence in the forecasting technique selected. The manager needs to have confidence that the forecasting information is accurate and that the manager has correctly interpreted the information. This confidence is directly related to the manager's understanding of the technique (20:29).

Techniques: Assumptions and Limitations. After the decision maker has considered the six criteria previously discussed, the decision maker can choose the technique that best fits the criteria. Additionally, the decision maker must also consider each forecasting technique's operating assumptions and limitations. The technique's assumptions and limitations must be matched as close as possible to the forecasting application and data format so that the forecasted values will be as close to actual values as possible.

The two types of forecasting models to be considered here are the time-series and causal or explanatory models. Time-series forecasting models such as naive, moving average, exponential smoothing and variations such as Box-Jenkins, double exponential smoothing and Winter's linear and seasonal exponential smoothing all work under the assumption that future values are related to historic time values and follow the basic pattern of previous data. Each time-series technique

places varying importance on different elements of the time-series pattern.

The naive technique is very simple and easy to apply. This technique assumes that no randomness exists in the data pattern and that the data is perfectly horizontal and has no trend, seasonal or cyclical components. The technique merely states that what the actual value in this period will be the forecasted value for the next period. Although the technique is not accurate in some applications, it can be used as a baseline to compare other forecasting techniques for appropriateness to an application (20:37).

Moving average attempts to decrease randomness in the data for short-term forecasting by averaging past data. This technique has a smoothing effect on the data pattern. The major limitations to this technique are the amounts of data needed, the technique's lack of consideration of trend, seasonal and cyclical characteristics, and the forecast's nonresponsiveness to immediate changes in actual values. For these reasons, moving average is generally used for short-term forecasting (20:54-60).

Exponential smoothing is more accurate than moving average techniques and operates under the assumption that the most recent data is the most accurate and a better predictor of future values. This technique needs only the last period's actual and forecasted values to forecast for the next period. Consequently, data requirements are significantly less than moving average. Exponential smoothing like moving average also attempts to eliminate randomness in the data. In order to counteract the data randomness, exponential smoothing uses a smoothing constant that tends to either suppress or accentuate the most

recent change in data depending on the application and the decision maker's need. Again, like moving average, exponential smoothing assumes the data pattern is horizontal and does not account for trend, seasonal or cyclical patterns (20:63-65).

Variations of time-series techniques such as Box-Jenkins, double exponential smoothing and Winter's linear and seasonal exponential smoothing attempt to account for the data patterns of trend, seasonal and cyclical that naive, moving average and exponential smoothing fail to capture. These more complicated techniques are still attempts to forecast assuming that future values will follow historic data patterns modified by time elements.

The purpose of this thesis research, outlined in the problem statement and the research questions in Chapter I, is to identify the maintenance production constraints that determine production output. Identifying these constraints will give the maintenance manager a realistic portrait of maintenance's capability to produce sorties. Building a forecasting model to predict production output given a set of constraints is an objective of this thesis but more important is understanding the relationships between the constraints and production output. Again, the purpose is to "paint a portrait" of production capability in order to help the maintenance manager better utilize maintenance resources increasing maintenance productivity. Time-series forecasting methods are not sufficient in identifying the relationships between constraints and production outputs.

Although time-series techniques are not suitable for this research, causal or explanatory models do attempt to identify relationships

between independent and dependent variables. "Explanatory forecasting assumes a cause and effect relationship between the inputs of the system and its output" (14:14). Multiple regression and correlation are excellent techniques to aid in understanding relationships between multiple variables. Multiple regression and correlation operate under the assumption that one or more independent variables can be used to predict the occurrence of a dependent variable.

Referring back to the discussion on the six criteria for choosing a forecasting model presented earlier, of the six criteria, the type of model must be the overriding criteria for selecting regression analysis. Although, the maintenance data used in this thesis may contain data pattern characteristics of trend, seasonality or cycles which would give the data characteristics of time where time-series techniques may be appropriate, the importance of this thesis lies in finding relationships between maintenance constraints and production outputs which leads the methodology selection to the causal or explanatory technique.

Summary. The forecasting section of the literature review presented the two classifications of forecasting techniques: quantitative and qualitative. This section also discussed the six criteria for selecting a forecasting technique: data pattern, model accuracy, model type, cost, lead time, and applicability. Time-series and causal or explanatory techniques were presented with assumptions and limitations. The researcher concluded that the most appropriate forecasting technique for this thesis application is a regression model based on the need for identification of variable relationships between maintenance constraints and production output.

Previous Research

A review of previous theses is important to increase the understanding of what knowledge already exists in the area of aircraft maintenance production as related to resource constraint's effect on production output. The review in this section will be organized by thesis presenting salient research findings and conclusions. The review includes three Air Force Institute of Technology (AFIT) theses that studied the relationships between aircraft maintenance constraints and production outputs. Each thesis incorporated a different methodology and analysis of different sets of data. The purpose of this review is to understand maintenance constraint and production output relationships identified in these theses and possibly find some correlations between the findings. The first review is a thesis studying MAC aircraft using telephone interviews, regression analysis and statistical correlation. The second thesis is research into Air Force Logistics Command (AFLC) depot-level aircraft maintenance using Data Envelopment Analysis (DEA) and regression analysis. The third thesis review is a study of Tactical Air Command (TAC) A-10 aircraft maintenance using Constrained Facet Analysis (CFA).

MAC Aircraft Maintenance. The first thesis is a study of aircraft maintenance productivity in MAC. The first phase of the thesis methodology included using a structured interview with an open ended question format. The interview findings were presented earlier in this chapter in the review of productivity measurement in DOD.

The second phase of the methodology evaluated the productivity measures most significant for measuring a unit's aircraft maintenance productivity. The evaluation categorized the productivity measures as

either inputs or outputs. The productivity measurement outputs were used as dependent variables in regression equations. The remaining measures were considered productivity inputs and treated as independent variables. Time constraints limited the researcher to analysis of data for six MAC airlift wings (8:80-81).

Using thirteen productivity measures found during the study, the researcher built a preliminary model that showed the relationship between maintenance inputs and production outputs. The researcher programmed a correlation matrix and ran statistical analysis on the thirteen productivity measures in order to determine the accuracy of the preliminary model. Collinear measures were identified as candidates for elimination from the preliminary model (8:81-82).

The final process for analysis of the model included stepwise regression. All measures were regressed to each of the six output measures using backward elimination. Of the six models produced through the regression process, one model appeared to contribute most significantly to explaining the productivity output. The preliminary model and the regressed model were compared to either confirm or question the relationships of the preliminary logical model. The productivity output measure with its contributing independent variables that best explained productivity were selected as the productivity model. The researcher performed residual analysis on the productivity model which further refined and validated the final logical model (8:82-83).

The final step in the research included combining the findings of the correlation and regression analyses to build the final logical model. This model supports a multi-level input-output set of

relationships between seven of the thirteen productivity measures found through the research process. The model identifies the following relationships (8:106):

1. Three inputs; cannibalization rate, awaiting maintenance discrepancies and average possessed aircraft correlate negatively (-), negatively (-) and positively (+) respectively to mission capable rate. When cannibalization rate and/or awaiting maintenance discrepancies decreases, the mission capable rate increases. When average possessed aircraft increases, the mission capable rate increases.

2. Another input, awaiting parts discrepancies, correlates negatively (-) to maintenance scheduling effectiveness, that is, as awaiting parts discrepancies increases maintenance scheduling effectiveness decreases.

3. Mission capable rate and maintenance scheduling effectiveness are inputs to the final model output; labor hour per flying hour. Mission capable rate correlates negatively (-) to labor hour per flying hour, that is, as mission capable rates increase the labor hour per flying hour expended decreases. Conversely, maintenance scheduling effectiveness correlates positively (+) to labor hour per flying hour, that is, as maintenance scheduling effectiveness increases labor hour per flying hour increases.

Recommendations of the researcher are consistent with the nature of the relationships highlighted by the logical model. Labor hour per flying hour, mission capable rate, maintenance scheduling effectiveness, cannibalization rates, delayed discrepancies and the average number of possessed aircraft appeared to be the maintenance factors that best indicated a maintenance units productivity (8:115).

AFLC Depot Level Maintenance. This thesis analyzed twenty months of aircraft maintenance data from the San Antonio Air Logistics Center, Aircraft Division. The researcher used Data Envelopment Analysis (DEA) to measure aircraft production efficiency at the aircraft division and regression analysis to identify the nature of the relationship between resource inputs and production outputs. The DEA is a analytical procedure whereby nonprofit organizations, such as the United States Air Force, can measure relative productivity of a Decision Making Unit (DMU) with itself over time or with DMUs of similar functions. DEA uses multiple resource inputs and multiple production outputs to measure the relative efficiency of the DMU with itself over multiple time periods or with other similar DMUs (13:37).

DEA declares a DMU to be relatively one hundred percent efficient when at least one of two conditions are achieved. The first condition is when the DMU can only increase output by either using more resource inputs or by reducing a portion of the DMU's other outputs. The second condition when one hundred percent efficiency may be declared is when the DMU can only reduce inputs by reducing its output or by consuming more of another input (13:38-39).

Analysis of the twenty months of production data using DEA is not necessarily important to the research of the current thesis from the stand-point of measuring production efficiency. The research is important to the current thesis when considering the slack of resource inputs for the twenty DMU periods. The input measures for the DEA analysis included material dollars and total direct labor hours (regular + overtime). The output measures included the quality deficiencies recorded during the Ready-For-Delivery audits, on-time deliveries and

total aircraft produced (13:51-52). The amount of slack constraint (when 0 slack occurs for an input) can be represented by a percentage relative to other input slack values. DEA results for the percentage of time an input suffered a slack constraint is as follows (13:90):

1. Total direct labor hours suffered a slack constraint 65 percent of the time.

2. Total material dollars suffered a slack constraint 25 percent of the time.

3. Overtime hours suffered a slack constraint 30 percent of the time.

4. One hundred percent efficiency occurred during DMU 2 and 10 where all three inputs suffered slack constraint.

The results of the DEA show that total labor hours suffered a slack constraint a significant portion of the twenty DMU periods. This would suggest that total labor hours is a strong factor in measuring aircraft maintenance productivity at this ALC and for the evaluated time period.

This research project also used regression analysis to identify which resource inputs were predictors of production outputs. The researcher decided to use total aircraft produced rather than on-time deliveries as the dependent variable for the regression analysis. The analysis used straight-data and the natural logs of direct labor hours, overtime hours, material dollars and total hours (direct + overtime hours) as independent variables (13:69).

After removing some of the randomness in the data by converting the twenty months to seven quarters of data, the researcher ran twelve regressions against total aircraft produced using different combinations of the independent variables. The results of the regressions indicate

that total labor hours (direct + overtime hours) may be a good indicator of the number of aircraft produced (13:72). The results of the regression analysis are consistent with the observation of DEA findings.

TAC A-10 Aircraft. This thesis analyzed A-10 Aircraft Maintenance Units (AMU) and aircraft using Constrained Facet Analysis (CFA) to measure performance in terms of relative efficiency. The data used in this research is actual data from an A-10 Tactical Fighter Wing possessing three AMU's. The sample size is a total of fifteen observations from the three AMU's. CFA is an out-growth of DEA presented in the previous discussion. This thesis is of interest not because of CFA performance evaluations of the AMUs, and therefore the CFA results will not be presented here. The researcher did perform correlation analysis on the AMU maintenance data inputs and outputs which is of importance.

The maintenance data included five productivity input measures for correlation analysis. The inputs are as follows (9:20-21):

1. Number of aircraft possessed.

2. The reciprocal of not mission capable maintenance (RNMCM). Not mission capable maintenance (NMCM) is a measure that limits aircraft production capability due to maintenance. For reasons peculiar to CFA, the researcher used the reciprocal of the measure which does not change its value but does change its direction. The RNMCM will appear to add to production capability rather than detract from it.

3. The reciprocal of not mission capable supply (RNMCS). Not mission capable supply (NMCS) is a measure that limits aircraft production capability due to a lack of parts availability charged to supply. Again, for reasons peculiar to CFA, the researcher used the

reciprocal of the measure which does not change its value but does change its direction. The PNMCS will appear to add to production capability rather than detract from it.

4. The number of flying days.

5. The fix rate. The fix rate is the number of aircraft malfunctions coded 3 that are fixed within a 8 hour time window following landing.

The maintenance data included two productivity output measures for correlation analysis. The outputs are as follows (9:19-20):

1. The number of sorties flown.

2. The mission capable time. Mission capable time for an AMU is the sum of fully mission capable time and partially mission capable time. Additionally, it is the sum of all mission capable time for aircraft maintained by the AMU.

The correlation results for the AMU data with correlation values more negative than -0.5 and more positive than +0.5, identifying inputs and outputs with the strongest correlations, are as follows (9:45):

1. The number of sorties produced (output) showed a negative correlation to number of flying days per period (input) at a -0.6289. This is an interesting finding because the expected correlation would be positive. As the number of flying days increases the number of sorties produced should increase with this increased opportunity to fly. The fact that it is negatively correlated may be due to the fact that training sorties are contracted at a set number not necessarily dependent on the number of flying days available. In the peace time environment, the number of flying days available is not necessarily a

constraint for sortie production. The negative correlation may be also due to some other characteristic of the particular data set.

2. The mission capable hours (output) is positively correlated to the number of aircraft possessed (input) at a +0.9438. This is expected due to the opportunity for more mission capable time because of the increased availability of aircraft.

Among the remaining findings of the correlation analysis, two other correlations are of interest. Number of sorties flown (output) is negatively correlated to RNMCM (input) at a -0.3875. RNMCM is the reciprocal of NMCM time which means that sorties flown is actually correlated positively to NMCM time at the same value. Though the strength of the correlation is relatively low, the direction of the correlation appears to be opposite from a logical understanding if the sorties flown and NMCM time are accepted as an output and input respectively. The correlation says that if NMCM time increases then sorties flown will increase. In reality, increased NMCM time should adversely effect sortie production and should decrease sorties flown. An explanation for this might be that NMCM time should be an output and sorties flown should be the input. Using this logic and the correlation reported in the research, as sorties flown (input) increases, NMCM time (output) increases. This explanation would be consistent with reality in that the more the aircraft fly the more opportunity exists for malfunction adding to the NMCM time.

<u>Summary</u>. The review of previous research helped in the understanding of the relationships between aircraft maintenance resource constraints and production outputs. The review included a thesis studying MAC aircraft using telephone interviews, regression analysis

and statistical correlation. The review also included research into AFLC depot-level aircraft maintenance using the Data Envelopment Analysis (DEA) and regression analysis. The third thesis review presented a study of TAC A-10 aircraft maintenance using Constrained Facet Analysis (CFA).

A significant understanding that came from this review is that what would be considered as an output in a manufacturing production system may not be true for a maintenance production system. The idea presented in the earlier NMCM and sortie rate discussion, sortie rates defined as an output and NMCM defined as an input of aircraft maintenance, may not be an accurate representation of the maintenance production system. Rather than producing high sortie rates as a measure of productivity, maybe reducing the NMCM time may be a more accurate measure and goal of the maintenance production effort.

Summary

The literature review examined two management disciplines as they relate to aircraft maintenance resource inputs determining maintenance production output. The two disciplines discussed included productivity measurement and forecasting principles. The third literature topic area presented an analysis of existing theses to identify maintenance constraints that act on production output.

The productivity measurement literature included discussion of productivity measurement concepts. The concepts were presented in the following order: productivity measurement defined; inputs, outputs and ratios; macro and micro measurements; productivity measurement in the Department of Defense.

Forecasting principles were also discussed with a concentration on understanding why regression analysis is chosen for this research project. Assumptions and limitations of different forecasting techniques were also presented.

A literature review examining previous theses findings and conclusions that studied the effect of maintenance constraints on production capability was also presented.

III. Methodology

Introduction

This chapter presents the methodology used to answer the research questions and consequently the problem statement in Chapter I. The research objective is to identify the aircraft maintenance constraint independent variables and production output dependent variables and understand how the constraints can be modelled to estimate production capability. Maintenance performance indicators are used as representative measures of maintenance constraints and production output. Identifying and modelling the relationships between the maintenance constraint and production measures will increase the maintenance manager's understanding of the production environment. The literature review in the fields of productivity measurement, forecasting principles, and previous research presented in Chapter II laid a foundation of background information that will aid in accomplishing the research objective. The methodology continues with the implementation of correlation analysis and stepwise regression modelling to better define the maintenance production environment using the performance indicators. The following discussion will further develop this methodology.

Data Treatment

The data for this research is management indicators obtained from current data files used at HQ SAC and in the wing maintenance organizations. HQ SAC/LGY provided twenty-one months of ex post facto maintenance performance indicators for the time period from January 1989

to September 1990. The data is for aircraft models KC-135A/D/E/Q, E-4B, KC-135R, RC-135V/N, EC-135A/C/G/L/N/Y, B-1B, B-52H, B-52G and FB-111A and is grouped by month for the twenty-one month period. There are nine data files (one per aircraft type) presented in Appendix A. The data file columns are variables and the rows are months listed from top to bottom; January 1989 to September 1990. The data is limited to production data available in the Maintenance Data Collection (MDC) system and the SAC maintenance analysis community. The performance indicators are extracted from SACP 66-17 or identified by the researcher's analysis of the HQ SAC/LGY spreadsheet titled "Aircraft Performance Indicators." The variable set is identified and categorized as either maintenance constraint independent variables in Table 2 or production output dependent variables in Table 3. Colonel Phillip L. Harris, HQ SAC/LGY, Director Logistics Analysis, identified the dependent variables as those production measures that maintenance managers at HQ SAC use regularly to assess maintenance system effectiveness.

The last six months of data for each aircraft type is extracted from the data set and will not be used during correlation analysis or forward stepwise regression modelling. The data will be used to validate the final forms of the twenty-seven regression models for the nine aircraft. The six months of data is for the period April 1990 to September 1990.

Correlation Analysis and Regression Modelling

Correlation analysis will assist in understanding how the maintenance constraints are related to production output. The

TABLE 2

MAINTENANCE CONSTRAINT INDEPENDENT VARIABLES

NOMENCLATURE	LABEL
Air Aborts	AAB
Air Abort Rate	AAR
Aircraft Breaks	ABK
Aircraft Break Rate	ABR
Aircraft Fix Rate	AFR
Aircraft Sortie Utilization Rate	ASU
Average Sortie Duration	ASD
Cancellations	CNX
Cancellation Rate	CXR
Cannibalizations	CAN
Cannibalization Rate	CNR
Full Mission Capable Rate	FMC
Hours Flown	HFN
Late Take-Offs	LTO
Late Take-Off Rate	LTR
Manhours Expended	MHE
Manhours Per Sortie	MHS
Manhours Per Flying Hour	MHF
Not Mission Capable Rate	NMC
Not Mission Capable Both Rate	NMB
Not Mission Capable Maintenance Rate	NMM
Not Mission Capable Supply Rate	NMS
Number Aircraft Fixed in 18 Hours	NFH
Partially Mission Capable Rate	PMC
Partially Mission Capable Both Rate	PMB
Partially Mission Capable Maintenance Rate	PMM
Partially Mission Capable Supply Rate	PMS
Possessed Aircraft	PSA
Possessed Hours	PSH
Sorties Attempted	SAT
Sorties Flown	SFN
Sorties Scheduled	SSD

TABLE 3

MAINTENANCE PRODUCTION OUTPUT DEPENDENT VARIABLES

NOMENCLATURE	LABEL
Mission Capable Rate	MCR
Total Not Mission Capable Maintenance Rate (TNMCM)	TNM
Total Not Mission Capable Supply Rate (TNMCS)	TNS

correlation analysis will attempt to find asymmetrical relationships between explanatory variables: maintenance constraint independent variables and production output dependent variable. In addition to identifying independent variables that help to explain the behavior of dependent variables, it will be important to identify if any moderating and extraneous variables exist for either use in or exclusion from the final regression model. It may also be necessary to make inferences about possible intervening variables in order to further explain the relationships between maintenance constraints and production output. In order to reduce the data set of independent variables that are best estimates of the dependent variables, computer programs for the SAS System for Elementary Statistical Analysis are written to run the correlation analysis and regression modelling. A sample of the computer programs are listed in Appendix B.

Correlation Analysis. The first test accomplished is the Pearson product moment coefficient of correlation r. This test will measure the strength of the linear relationship between maintenance constraint independent variables and production output dependent variables. The

correlation coefficient scale is from -1 to +1 with 0 showing no correlation between independent and dependent variables and -1 and +1 showing the strongest correlation for a negative and positive relationship respectively (16:514). Using the SAS program, the data set of thirty-two independent variables and three dependent variables will be correlated for each of the nine aircraft types. The strength and nature (from +1 to -1) of the correlation values between the independent and dependent variables will assist in identifying those independent variables that stepwise regression should include in the final forms of the maintenance model. Whether or not stepwise regression will actually include the variable in the model is dependent on how strong the maintenance constraint is correlated to the production output and the regression model's t-test significance level and its probability value for the maintenance constraint beta parameter.

A problem that may occur is collinearity of the maintenance constraint independent variables. This occurs when two or more independent variables are highly correlated with each other. One of the benefits of using stepwise regression is its tendency to correct this problem by including only one of the collinear variables in the regression model (16:624). For this reason, collinearity will be handled using stepwise regression.

Stepwise Multiple Regression. The maintenance data will be fitted to a probabilistic model using stepwise multiple regression. "A systematic approach to building a model with a large number of independent variables is difficult because the interpretation of multivariate interactions and higher-order polynomials is tedious" (16:722). Due to the complex process of modelling thirty-two

independent variables, the maintenance model will be built using stepwise regression. Forward stepwise regression will be used to find the form of the maintenance model that best describes the relationships between the maintenance constraints and production output. The three production output dependent variables in Table 3 will be regressed using the thirty-two maintenance constraint independent variables in the data set identified in Table 2. The result will be each of the nine aircraft types will have three regression models built using the three dependent variables for a total of twenty-seven regression models. After building three models for each aircraft type, each production output measure for all nine aircraft will be examined for common maintenance constraints that might explain the maintenance system in general.

The coefficient of determination R-squared and the F-statistic will be used in combination to measure how well the maintenance models fit the maintenance performance indicators. These tests are global measures that will evaluate all of the maintenance constraint beta parameters and will test the usefulness of the maintenance model. The R-squared statistic will reflect the ratio of variability explained by the maintenance constraints over total model variability. An R-squared value equal to 0 implies the model does not fit the data and a value of 1 implies a perfect fit between the data and the model, thus the scale is 0 to 1 (16:575).

The F-statistic will be used to identify how much of the occurrence of the production output is left unexplained by the regression model.

> The F statistic is the ratio of the explained variability divided by the model degrees of freedom to the unexplained variability divided by the error degrees of freedom. Thus, the larger proportion of total variability accounted for by the model, the larger the F statistic. (16:576)

The F-statistic, the probability value greater than F, the coefficient of determination R-squared, the beta parameter t value, and the probability greater than the absolute value of t measures cannot be used in isolation from one another and in doing so would be insufficient to make a decision on the usefulness of the model. The model's usefulness can only be determined by evaluating the significance of the statistical measures in concert with each other.

Residual analysis will be used to check the regression assumptions that the maintenance data set random errors are normally distributed with a mean of 0, the random error variance is equal to sigma squared and the random errors are independent. It is necessary that the variance of the random error component of the regression model be constant in order to use the least squares estimators. If the random error variance is not constant, then transformation procedures will be performed on those maintenance constraint independent variables in question (16:557-558;728-730).

Model Validation

The regression model will be validated using six months of maintenance data for each aircraft type. The validation procedure is to run the regression model using the six months of data to see how close to actual historic production measures the model can predict. Three confidence intervals for the predicted value will be used to estimate a range for predicting a specific production capability for a given set of maintenance constraints present in the model. The validation test is the final measure of whether or not the maintenance model is useful at predicting production capability at a determined confidence level.

Justification

The research objective is to find the best estimators of production capability in SAC aircraft maintenance. Multiple regression analysis is a powerful estimating and prediction tool. Multiple regression allows for the modelling of a dependent variable (y) as a function of two or more independent variables (16:555). For example, modelling production output [E(y)] as a function of production constraints (x1, x2, . . . ,xn). The statistical tests discussed in this chapter will answer research questions two, three and four and answer the problem statement in this thesis.

Summary

This chapter discussed the methodology to be used for this research project. The researcher accomplished a literature review to lay a foundation in productivity measurement, forecasting principles, and previous maintenance research. This study gives the researcher the tools to accomplish the research objective and the reader background information to understand the problem and the final recommendations.

Statistical analysis will be performed to answer research questions two, three and four. The statistical tests will be run in concert with the regression analysis to aid in building an accurate regression model of maintenance production capability.

Chapter IV, Findings and Analysis, statistically analyzes the data and reports the findings of the research. The form of the regression model that most accurately fits the data set will be presented with discussion as to its significance. Additionally, discussion of the individual statistical test results will be presented.

IV. Findings and Analysis

Introduction

This chapter presents answers to the research questions and consequently the problem statement identified in Chapter I. A correction to the maintenance constraint table presented in Chapter III is presented at the beginning of this chapter. Research question 1 results are presented prior to discussing individual aircraft statistical analysis and regression modelling used to answer research questions 2, 3 and 4. The remainder of the chapter is organized by aircraft type. All nine aircraft are discussed individually beginning with correlation analysis. A table identifying the maintenance constraint and production output measure correlations is presented to answer research questions 2 and 3. The table with appropriate discussion identifies which maintenance constraints limit or enhance production capability. Additionally, the statistical relationship between the maintenance constraints and production output is identified. Second, the results of forward stepwise regression modelling is presented including maintenance constraints selected and the model's global measures. Third, findings of residual analysis are presented with changes to the regression model where appropriate. Finally, model validation results are presented with 90%, 95% and 99% confidence intervals for the predicted value using the six months validation data for each aircraft type. Following the discussion of all nine individual aircraft, correlation analysis and regression modelling results will be aggregated looking for commonalities between the product output measures for the nine aircraft types.

Modified Variable Table

The preliminary maintenance constraint categorization presented in Table 2 of Chapter III is modified in Table 4. The modification is necessary due to results of correlation analysis where maintenance constraints are found to be highly correlated with the production outputs and are now excluded. This collinearity adds no meaningful research information; maintenance constraints were sub-measures or in some cases inverse measures of production outputs. The three production outputs identified in Table 3 of Chapter III remain unchanged and will be correlated and regressed against the twenty-three maintenance constraints in Table 4.

Production Capability Measures

The objective of research question 1 is to identify the existing measures of aircraft maintenance production capability in SAC. The performance indicators listed in Appendix C are extracted from the HQ SAC/LGY Spreadsheet and SACP 66-17 and are existing measures of aircraft maintenance production capability. The measures are available for maintenance managers to use both at headquarters and wing organizational levels. Additionally, the measures can be used in research to increase the understanding of maintenance production capability. A complete set of data for all performance measures identified in Appendix C is not available for incorporation into this research.

KC-135A/D/E/Q

The first analysis is for the KC-135A/D/E/Q aircraft. The results of correlation analysis and regression modelling for this aircraft

TABLE 4

MAINTENANCE CONSTRAINT INDEPENDENT VARIABLES

NOMENCLATURE	LABEL
Air Aborts	AAB
Air Abort Rate	AAR
Aircraft Breaks	ABK
Aircraft Break Rate	ABR
Aircraft Fix Rate	AFR
Aircraft Sortie Utilization Rate	ASU
Average Sortie Duration	ASD
Cancellations	CNX
Cancellation Rate	CXR
Cannibalizations	CAN
Cannibalization Rate	CNR
Hours Flown	HFN
Late Take-Offs	LTO
Late Take-Off Rate	LTR
Manhours Expended	MHE
Manhours Per Sortie	MHS
Manhours Per Flying Hour	MHF
Number Fixed in 12 Hours	NFH
Possessed Aircraft	PSA
Possessed Hours	PSH
Sorties Attempted	SAT
Sorties Flown	SFN
Sorties Scheduled	SSD

and the remaining eight aircraft is presented and will answer research questions 2 and 3.

Correlation Analysis. The SAS correlation analysis output is presented in Appendix D.1. A summary of the correlation analysis is presented in Table 5 and identifies the coefficient of correlation with associated p-values for the relationships between the three production output and twenty-three maintenance constraint measures that correlated at or below a .05 significance level.

TABLE 5

KC-135A/D/E/Q CORRELATION ANALYSIS SUMMARY

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Aircraft Hours Flown	0.61229 0.0153	-0.59056 0.0205	*
Manhours Expended	0.52863 0.0428	-0.51781 0.0480	*
Possessed Aircraft	0.58762 0.0212	-0.56518 0.0281	-0.62903 0.0120
Possessed Hours	0.53538 0.0397	*	-0.53240 0.0410
Sorties Attempted	0.63840 0.0104	-0.62193 0.0133	*
Sorties Flown	0.59090 0.0204	-0.56519 0.0278	*
Sorties Scheduled	0.61622 0.0144	-0.62498 0.0127	*
Aircraft Fix Rate	0.66381 0.0070	-0.64096 0.0100	-0.63628 0.0108

"*" Indicates correlation p-value greater than 0.05

The objective of research questions 2 and 3 is to identify the maintenance constraints that limit or enhance production capability and to understand the statistical nature of the relationships. Using Table 5 as a reference, the following is given as possible rationale why the maintenance constraints are correlated to the three production output measures.

1. MC Rate. The correlation between aircraft hours flown, sorties attempted, sorties flown, and sorties scheduled is highly significant at 0.0001. This indicates the four measures may be contributing similar information to determining MC rate. The MC rate is positively correlated with all four maintenance constraints. As aircraft hours flown, sorties attempted, sorties flown, and/or sorties scheduled increases MC rate increases. These results are more clearly understood when thinking of MC rate determining the number of hours flown, sorties attempted, flown and scheduled. The higher the MC rate the more time aircraft are available for sortie generation. As MC rate increases hours flown, sorties attempted, flown and scheduled increases. Explaining the correlation in terms of MC rate as the production output, the correlation may be the result of the often sighted maintenance philosophy that the more the aircraft flies the less it breaks.

MC rate is positively correlated with man-hours expended. As man-hours expended increases MC rate increases. This finding reinforces the idea that maintenance is labor intensive and the production quantity and speed at which aircraft are fixed is directly related to labor expended.

The correlation between possessed aircraft and possessed hours is highly significant at 0.0001. This indicates both measures may be contributing similar information to determining MC rate. Possessed aircraft and possessed hours are positively correlated to MC rate, that is as possessed aircraft and/or hours increases MC rate increases. Initially, this finding would appear inconsistent with the MC rate ratio. With possessed hours as the denominator in the MC rate ratio, it appears the correlation should be negative. As the denominator increases, the rate should decrease. However, this would not be true if

a greater percentage of increased possessed time is MC time rather than NMC time. As possessed time increases the percentage of MC time increases. This may be supported and confirmed by the negative correlation relationship between TNMCM and TNMCS rates and possessed aircraft and hours in Table 5. As the possessed time increases the percentage of NMC time decreases.

Aircraft fix rate is positively correlated with MC rate. As aircraft fix rate increases MC rate increases. An increase in aircraft fix rate means more aircraft breaks are fixed in the first 18 hours after landing which means more possessed time is spent as MC time.

2. TNMCS Rate. The TNMCS rate is negatively correlated to aircraft hours flown, sorties attempted, sorties flown and sorties scheduled. This finding supports the rationale given for positive correlation with MC rate. TNMCS time (with TNMCM time) is the antithesis of MC time; as MC time increases TNMCS (and TNMCM) time decreases. This is supported by the highly significant negative correlation between MC rate and TNMCS and TNMCM rates at 0.0001.

Man-hours expended is negatively correlated to TNMCS rate, that is as man-hours expended increases TNMCS rate decreases. As more parts are replaced more man-hours are expended to install the parts and TNMCS time decreases.

TNMCS rate is negatively correlated to possessed aircraft but not to possessed hours. The rationale for the correlation is given above under MC rate correlation with the exception that as possessed aircraft increases percentage of TNMCS time decreases.

Aircraft fix rate is negatively correlated to TNMCS rate. As aircraft fix rate increases TNMCS rate decreases. An increase in

aircraft fix rate means that more aircraft are fixed in the first 18 hours thereby decreasing the amount of accumulated TNMCS time on the aircraft.

3. TNMCM Rate. TNMCM rate is not correlated with aircraft hours flown, sorties attempted, sorties flown and sorties scheduled nor is it correlated to man-hours expended. This would appear contradictory to the findings between these maintenance constraints for MC and TNMCS rates. The measures are negatively correlated to TNMCM rate but at a higher p-value than 0.05. This finding may be due to the particular data set analyzed rather than no correlation.

Possessed aircraft and hours are negatively correlated to the TNMCM rate. As possessed aircraft or hours increases TNMCM rate decreases. Again, the rationale given for possessed aircraft and possessed hours correlation to MC and TNMCS rate supports this finding.

Aircraft fix rate is negatively correlated to TNMCM rate. As aircraft fix rate increases TNMCM rate decreases. The more aircraft fixed in the first 18 hours the less time the aircraft spends accumulating TNMCM time.

Stepwise Regression. The forward stepwise regression results for the KC-135A/D/E/Q, as well as the remaining aircraft types, will answer research question 4 as to which maintenance constraints can be used in a predictive model of a maintenance organization's sortie producing capability. The SAS regression output is presented in Appendix E.1. A summary of the forward stepwise regression results is presented in Table 6 and should be referenced for the following discussion.

MC Rate Regression Model. The maintenance constraints that contribute information to predicting MC Rate for the KC-135A/D/E/Q

TABLE 6

KC-135A/D/E/Q STEPWISE REGRESSION RESULTS

Mission Capable Rate	Rsquare	F-Value	Prob>F
Model Form	0.98744	104.83	0.0001

MCR = 38.046
+ 0.759(CXR)
+ 0.001(HFN)
- 0.014(LTO)
- 0.043(MHS)
+ 0.101(PSA)
+ 0.243(AFR)

Model Useful (F>F-Alpha)
F-Alpha Value

0.10	0.05	0.01
2.67	3.58	6.37

TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.95600	39.11	0.0001

TNMCS = 51.326
- 1.322(ASD)
- 0.104(PSA)
+ 0.0001(PSH)
- 0.005(SSD)
- 0.198(AFR)

Model Useful (F>F-Alpha)
F-Alpha Value

0.10	0.05	0.01
2.61	3.48	6.06

TNMCM Rate	Rsquare	F-Value	Prob>F
Model Form	0.92366	30.25	0.0001

TNMCM = 33.944
- 0.025(CNX)
+ 0.154(MHF)
- 0.073(PSA)
- 0.117(AFR)

Model Useful (F>F-Alpha)
F-Alpha Value

0.10	0.05	0.01
2.61	3.48	5.99

* Constraint parameters rounded to the third decimal position (EXCEPTION: TNMCS MODEL PSH).

aircraft are cancellation rate, aircraft hours flown, late take-offs, man-hours per sortie, possessed aircraft, and aircraft fix rate. The regression model is useful at 0.10, 0.05, and 0.01 significance levels.

The 104.83 F-value is greater than the F-Alpha values, and the 0.0001 Prob>F is less than the alpha significance levels. The maintenance constraints explain 98.74% of the total MC rate variability as indicated by the R-square value.

Three of the six maintenance constraints selected for inclusion in the model; aircraft hours flown, possessed aircraft, and aircraft fix rate are significant at 0.0001 and identified during correlation analysis at or below 0.05. The positive variable parameters suggests as aircraft hours flown, possessed aircraft, and aircraft fix rate increases MC rate increases. This is consistent with correlation analysis findings. The highly significant probability value suggests these three constraints add the most information to predicting MC rate. The cancellation rate's positive parameter increases the MC rate value. This is logical if the cancellation rate increase is due to reasons other than aircraft breaks. Late take-offs and man-hours per sortie subtract from MC rate suggesting that as these maintenance constraints increase MC rate decreases. This is logical if the reasons for late take-offs and increased labor is due to aircraft breaks.

<u>TNMCS Rate Regression Model.</u> The maintenance constraints contributing information to predicting TNMCS rate are aircraft sortie duration, possessed aircraft, possessed hours, sorties scheduled and aircraft fix rate. The TNMCS model is useful for predicting TNMCS rate at 0.10, 0.05, and 0.01 significance levels. The 39.11 F-value is greater than the F-Alpha values, and the 0.0001 Prob>F is less than the alpha significance levels. The maintenance constraints explain 95.60% of total TNMCS rate variability as indicated by the R-square value.

Three maintenance constraints possessed aircraft, sorties scheduled, and aircraft fix rate are significant at 0.0004, 0.0001, and 0.0001 respectively and identified during correlation analysis at or below 0.05. The maintenance constraint negative parameters confirms the relationships found in correlation analysis that decreasing one or more of the constraints will increase TNMCS rate. Possessed aircraft, sorties scheduled, and aircraft fix rate contribute the most information to predicting TNMCS rate.

TNMCM Rate Regression Model. Cancellations, man-hours per flying hour, possessed aircraft, and aircraft fix rate provides information to predicting TNMCM rate. The model is useful at predicting TNMCM rate at 0.10, 0.05, and 0.01 significance levels. The 30.25 F-value is greater than the F-Alpha values, and the 0.0001 Prob>F is less than the alpha significance levels. The total TNMCM variability explained by the model is 92.37% indicated by the R-square value.

Two of the four maintenance constraints; possessed aircraft and aircraft fix rate contribute information to the model at a 0.0001 and 0.0009 significance levels respectively and are negatively correlated at or below 0.05. Cancellations decreases the TNMCM rate because of the negative parameter. This would be the case for cancellations due to reasons other than aircraft breaks. One other maintenance constraint worth noting is man-hours per flying hour. The man-hours per flying hour beta parameter is positive adding significantly to TNMCM rate at 0.0002 Prob>F, although the constraint did not identify during correlation analysis.

Residual Analysis. Residual analysis plots of all three model's predicted values and maintenance constraints were studied and appear to

be random indicating no need of further model improvement. No other maintenance constraint configuration will improve model performance.

<u>Model Validation.</u> The actual values, predicted values, and confidence intervals for the predicted values computed by SAS for the six months validation data are presented in Appendix G.1. A summary of validation results for MC, TNMCS, and TNMCM rate models is presented in Table 7 showing the actual and predicted values for the dates indicated.

TABLE 7

KC-135A/D/E/Q VALIDATION RESULTS

	MC Rate		TNMCS Rate		[illegible] Rate	
Date	Actual	Pred.	Actual	Pred.	[illegible]	Pred.
Apr 90	83.6 ***	81.70	9.2	1[illegible]	[illegible] *	12.55
May 90	86.2 *	86.39	8.1 **	9.[illegible]	[illegible]	10.38
Jun 90	85.4	83.56	8.3	11.9[illegible]	[illegible]	11.31
Jul 90	86.6	81.44	7.8	13.04	[illegible]	12.40
Aug 90	88.9 **	87.17	6.5	9.96	[illegible] ***	9.85
Sep 90	87.3	80.22	7.3	15.53	[illegible]	[illegible].54

* 90% (0.10 alpha)
** 95% (0.05 alpha)
*** 99% (0.01 alpha)

Additionally, asterisks are used to indicate where actual values are included in 90%, 95%, or 99% confidence intervals for the predicted values.

The confidence interval for the predicted value indicates the confidence level that the actual value is within the specified interval. For example, a 90% confidence interval for the predicted value means there is a 90% confidence level the actual measure of interest is

included in the interval. In other words, 10% of the actual values will not be included in the interval. An actual value included in the respective confidence interval validates the computed interval for the single observation and is an indication of the accuracy of the model.

Three validation samples in the MC rate model are not included in the confidence intervals for the predicted values as identified by the absence of asterisks. May 1990, August 1990, and April 1990 MC rate actual values are included in the 90%, 95%, and 99% confidence intervals respectively. One TNMCS rate actual value, May 1990, is included in the 95% confidence interval, and the remaining five were not in any of the three intervals. Three TNMCM rate actual values are included in the 90% interval, April-June 1990, and August 1990 TNMCM rate is included in the 99% confidence interval.

KC-135R

Correlation Analysis. The SAS correlation analysis output is presented in Appendix D.2. The correlation analysis results for the KC-135R aircraft are summarized in Table 8 and should be referenced for the following discussion.

1. MC Rate. The MC rate is negatively correlated with average sortie duration. As average sortie duration increases MC rate decreases. The longer the aircraft mission the longer systems are operating giving malfunctions a broader window to manifest.

Cancellations and cancellation rate are highly correlated at a 0.0001 significance level. Both maintenance constraints are negatively correlated to MC rate. As cancellations or cancellation rate increases MC rate decreases. Cancellations and cancellation rate increases

TABLE 8

KC-135R CORRELATION ANALYSIS SUMMARY

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Average Sortie Duration	-0.59542 0.0219	*	0.57588 0.0247
Cancellations	-0.77820 0.0006	0.68762 0.0046	0.59745 0.0187
Cancellation Rate	-0.82796 0.0001	0.76346 0.0009	0.63982 0.0102
Late Take-Off Rate	-0.51756 0.0482	*	*

"*" Indicates correlation p-value greater than 0.05

because of deviations to scheduled sorties attributed to one or a combination of higher headquarters, operations, maintenance, supply and other reasons. If the cancellation is due to supply or maintenance, then it is probably due to broken aircraft causing MC rate to decrease.

MC rate is negatively correlated to late take-off rate. As late take-off rate increases MC rate decreases. Again, late take-offs can be attributed to one or a combination of reasons cited for cancellations. If the reason for the late take-off is material or maintenance, then delay time is subtracted from MC time decreasing MC rate.

2. TNMCS Rate. The TNMCS rate is positively correlated to cancellations and cancellation rate. As cancellations or cancellation rate increases TNMCS rate increases. Cancellations chargeable to supply stem from supply's inability to deliver required parts in time to fix

the aircraft and meet its mission. These cancellations add to accumulated aircraft NMC time increasing TNMCS rate.

3. TNMCM Rate. Average sortie duration is positively correlated to TNMCM rate. As average sortie duration increase TNMCM rate increases. This finding supports the rationale given for the positive correlation between MC rate and average sortie duration.

Cancellations and cancellation rate are positively correlated to TNMCM rate. The same rationale given for the correlation between TNMCS rate and cancellations and cancellation rate applies. The exception is cancellations would be attributable to maintenance and not to deficient supply support.

Stepwise Regression. The SAS stepwise regression output for the KC-135R aircraft is presented in Appendix E.2. The regression results of the three production output measures are summarized in Table 9 and should be referenced for the following discussion.

MC Rate Regression Model. The MC rate model's measures of interest are good and indicates the model is useful for predicting MC rate at 0.10, 0.05, and 0.01 significance levels. The 32.36 F-value is greater than the F-Alpha values, and the 0.0001 Prob>F is less than the alpha significance levels. The R-square indicates the maintenance constraints regressed; air aborts, air abort rate, cancellation rate and cannibalizations explain 92.83% of total MC rate variability.

Cancellation rate is the only maintenance constraint entered into the model correlated with the production output measure at or below 0.05. Increasing cancellation rate decreases MC rate. This is opposite in nature to the cancellation rate correlation with MC rate identified in the KC-135A/D/E/Q MC rate model. MC rate would decrease if

TABLE 9

KC-135R STEPWISE REGRESSION RESULTS

Mission Capable Rate	Rsquare	F-Value	Prob>F
Model Form	0.92828	32.36	0.0001
MCR = 80.193 - 0.197(AAB) + 0.564(ABR) - 3.187(CXR) + 0.063(CAN)	Model Useful (F>F-Alpha) F-Alpha Values		
	0.10	0.05	0.01
	2.61	3.48	5.99

TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.93067	33.56	0.0001
TNMCS = 3.267 + 1.676(CXR) - 0.023(CAN) + 0.104(MHF) + 0.037(AFR)	Model Useful (F>F-Alpha) F-Alpha Values		
	0.10	0.05	0.01
	2.61	3.48	5.99

TNMCM Rate	Rsquare	F-Value	Prob>F
Model Form	0.74858	7.44	0.0048
TNMCM = 14.939 + 0.199(AAB) - 0.603(ABR) + 1.904(CXR) - 0.044(CAN)	Model Useful (F>F-Alpha) F-Alpha Values		
	0.10	0.05	0.01
	2.61	3.48	5.99

* Constraint parameters rounded to the third decimal position.

cancellations are due to aircraft breaks. Of the four constraints, cancellation rate possesses the highest F-Statistic and a significance level of 0.0001 which indicates it contributes the most information to the model. Cannibalizations contribute positively to the model at

0.0004 significance level. Cannibalizations performed in lieu of accumulating NMC time waiting for supply to fill a requisition will increase MC rate. Air aborts and air abort rate parameters are negative and positive in nature respectively. This appears to be contradictory due to air aborts and air abort rate highly significant positive correlation with each other at 0.0001 significance.

TNMCS Rate Regression Model. The TNMCS rate model is useful at predicting TNMCS rate at 0.10, 0.05, and 0.01 significance levels. The 33.56 F-value is greater than the F-Alpha values, and the 0.0001 Prob>F is less than the alpha significance levels. Cancellation rate, cannibalizations, man-hours per flying hour, and aircraft fix rate explain 93.07% of the total TNMCS rate variability.

Cancellation rate is highly significant at 0.0001 adding to TNMCS rate with a positive parameter value. This is consistent with the findings of correlation analysis and supports the proposition that a portion of the cancellations are the result of aircraft breaks leading to material delays. Cannibalizations contribute to reducing TNMCS rate which is consistent with the purpose of cannibalization to provide spare parts when base supply is zero balance. Man-hours per flying hour and aircraft fix rate increase TNMCS rate as one or both maintenance constraints increase. Man-hours per flying hour causes an increase in TNMCS if maintenance performed results in parts back order conditions on aircraft. The aircraft fix rate positive relationship with TNMCS rate model is not logical in that an increase in aircraft fix rate should decrease TNMCS rate.

TNMCM Rate Regression Model. The TNMCM model measures of interest deviate significantly from the strength of those shown in the

other two models, although the model is still useful for predicting the TNMCM rate at 0.10, 0.05, and 0.01 significance levels. The 7.44 F-value is greater than the F-Alpha values, and the 0.0048 Prob>F is less than the alpha significance levels. The R-Square indicates air aborts, air abort rate, cancellation rate, and cannibalizations explain 74.86% of the total TNMCM rate variability.

It is interesting to note the four maintenance constraints are the same as those entered into the MC rate model but with opposite natures. Of the four constraints, the cancellation rate is the most significant in contributing to the model at 0.0006. This is consistent with the proposition that cancellations are the result of aircraft breaks in contrast to other reasons than maintenance or supply. The rationale given for air aborts, air abort rate, and cannibalizations is the same as that given in the MC model discussion but with the opposite result on the value of the production output.

Residual Analysis. The SAS residual analysis output for the three regression models is presented in Appendix F.2. The analysis revealed the TNMCS rate production output man-hours per flying hour produced a curvature in the residual plot indicating the need for a quadratic term. A summary of the modified regression model is presented in Table 10. The model continues to be useful for predicting TNMCS rate at 0.10, 0.05, and 0.01 significance levels. The F-value increased to 39.11, and the Prob>F decreased to 0.0001. The R-square improved and indicates that the modified model explains 95.60% of the total TNMCS rate variability. The modified model appears stronger and will be used in place of the original for model validation.

TABLE 10

KC-135R STEPWISE REGRESSION
RESIDUAL MODIFICATIONS

TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.95601	39.11	0.0001
TNMCS = 13.213	Model Useful (F>F-Alpha) F-Alpha Values		
+ 1.745(CXR)			
- 0.017(CAN)			
- 0.484(MHF)	0.10	0.05	0.01
+ 0.008(SQMHF)			
+ 0.035(AFR)	2.61	3.43	6.06

* Constraint parameters rounded to the third decimal position.

Model Validation. The validation results computed by SAS for the six months validation data are presented in Appendix G.2 A summary of the validation is presented in Table 11 and should be referenced for the following discussion.

The MC rate actual values for April and May 1990 are included in the 90% and 99% confidence intervals respectively. The remaining observations, June-September 1990, are not included in any interval. The TNMCS rate for April 1990 is included in the 90% confidence interval, although the remaining months are not included in any interval. Three months are included in one of the three confidence intervals for TNMCM rate. April and May 1990 are included in the 90% interval and June 1990 is included in the 99% interval. The remaining months July-September 1990 are not included in the intervals.

TABLE 11

KC-135R VALIDATION RESULTS

	MC Rate		TNMCS Rate		TNMCM Rate	
Date	Actual	Pred.	Actual	Pred.	Actual	Pred.
Apr 90	87.6 *	86.04	8.6 *	7.82	8.1 *	9.66
May 90	86.4 ***	89.41	2.2	6.45	10.1 *	7.77
Jun 90	89.3	82.24	6.1	9.95	7.6 ***	12.51
Jul 90	88.5	80.99	6.9	9.25	7.9	13.92
Aug 90	92.8	83.44	4.4	7.09	5.0	12.11
Sep 90	92.0	81.93	4.8	7.37	4.7	13.78

* 90% (0.10 alpha)
** 95% (0.05 alpha)
*** 99% (0.01 alpha)

RC-135V/N

Correlation Analysis. The SAS correlation analysis output for the RC-135V/N aircraft is presented in Appendix D.3. A summary of the correlation results is presented in Table 12 for those maintenance constraints correlated with the three production outputs at or below 0.05 significance.

1. MC Rate. The MC rate is not correlated with any maintenance constraints for the RC-135V/N at 0.05.

2. TNMCS Rate. Possessed hours is negatively correlated with TNMCS rate, that is as possessed hours increase TNMCS rate decreases. The KC-135A/D/E/Q MC rate is positively correlated to possessed hours and the rationale given is as possessed hours increase the proportion of possessed hours spent as MC time increases. As the MC time increases TNMCS time decreases. The finding that TNMCS rate decreases as the possessed hours increases supports the KC-135A/D/E/Q MC rate finding.

TABLE 12

RC-135V/N CORRELATION ANALYSIS SUMMARY

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Cancellation Rate	*	*	0.55942 0.0301
Possessed Hours	*	-0.55316 0.0324	*

"*" Indicates correlation p-value greater than 0.05

3. <u>TNMCM Rate.</u> The TNMCM rate is positively correlated to cancellation rate; as cancellation rate increases TNMCM rate increases. Reference the discussion for the similar KC-135R correlation finding.

<u>Stepwise Regression.</u> The SAS forward stepwise regression output for the RC-135V/N aircraft is presented in Appendix E.3. The regression results for the three production output measures are summarized in Table 13 and should be referenced for the following discussion.

<u>MC Rate Regression Model.</u> The MC rate regression models' measures of interest at the 0.05 and 0.01 significance levels indicate the model is not useful for predicting MC rate. The 4.53 F-value is less than the F-Alpha values, and the 0.0530 Prob>F is greater than the alpha significance levels. However, the model appears to be useful at the 0.10 significance level although the R-square indicates only 25.84 percent of the total MC rate variability is attributable to possessed hours.

TABLE 13

RC-135V/N STEPWISE REGRESSION RESULTS

Mission Capable Rate	Rsquare	F-Value	Prob>F
Model Form	0.2584	4.53	0.0530
MCR = - 11.032 + 0.197(PSH)	Model Useful (F>F-Alpha) F-Alpha Values		
	0.10	0.05	0.01
	3.14	4.67	9.07
TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.5969	5.429	0.0155
TNMCS = 80.648 + 0.475(ABR) + 51.791(CNR) - 0.010(PSH)	Model Useful (F>F-Alpha) F-Alpha Values		
	0.10	0.05	0.01
	2.66	3.59	6.22
TNMCM Rate	Rsquare	F-Value	Prob>F
Model Form	0.3130	5.922	0.0301
TNMCM = 22.482 + 0.660(CXR)	Model Useful (F>F-Alpha) F-Alpha Values		
	0.10	0.05	0.01
	3.14	4.67	9.07

* Constraint parameters rounded to the third decimal position.

Possessed hours is the only maintenance constraint entered in the regression model and possesses a positive parameter value indicating it

adds to MC rate. Possessed hours did not identify during correlation analysis at 0.05 significance.

TNMCS Rate Regression Model. The TNMCS rate model appears useful at 0.10 and 0.05 with aircraft break rate, cannibalization rate and possessed hours explaining 59.69 percent of the total TNMCS rate variability. The 5.429 F-value is greater than the F-Alpha values, and the 0.0155 Prob>F is less than the alpha significance levels. However, at 0.01 alpha significance the model is not useful. The F-value is less than F-Alpha and Prob>F is greater than the alpha significance level.

The positive parameter aircraft break rate and cannibalization rate indicates the two maintenance constraints add to TNMCS rate, and the negative possessed hours parameter indicates possessed hours reduce TNMCS rate. Aircraft break rate and cannibalization rate did not identify during correlation although possessed hours did identify, and the constraint parameter relationship nature to TNMCS rate agrees with the correlation finding.

TNMCM Rate Regression Model. The model is useful for predicting the TNMCM rate at 0.10 and 0.05 significance levels. The 5.922 F-value is greater than the F-Alpha values, and the 0.0301 Prob>F is less than the alpha significance levels. The model is not useful at 0.01 significance where the F-value is less than the F-Alpha value. Cancellation rate explains 31.30 percent of the total TNMCM rate variability indicated by the R-square value. Cancellation rate positive parameter increases TNMCM rate as cancellations increase. This is consistent with correlation analysis findings.

Residual Analysis. Residual analysis of the production output measures and the model's maintenance constraints reveals the TNMCS rate

model cannibalization rate possesses a concave plot. This plot indicates the need for a quadratic term. Additionally, the TNMCM rate model's maintenance constraint cancellation rate possessed a concave plot indicating it also requires a quadratic term in the model. The SAS residual output products are presented in Appendix F.3. A summary is presented in Table 14 and should be referenced for the following discussion.

TABLE 14

RC-135V/N STEPWISE REGRESSION
RESIDUAL MODIFICATIONS

TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.7367	10.261	0.0016
TNMCS = 117.593 − 246.369(CNR) + 1400.541(SQCNR) − 0.011(PSH)	Model Useful (F>F-Alpha) F-Alpha Values		
	0.10	0.05	0.01
	2.66	3.59	6.22
TNMCM Rate	Rsquare	F-Value	Prob>F
Model Form	0.3860	8.173	0.0134
TNMCM = 23.974 + 0.052(SQCXR)	Model Useful (F>F-Alpha) F-Alpha Values		
	0.10	0.05	0.01
	3.14	4.67	9.07

* Constraint parameters rounded to the third decimal position.

<u>TNMCS Rate Regression Model.</u> Entering the quadratic terms in the TNMCS and TNMCM rate regression models improved the F-values,

Prob>F, and R-Squared values. The TNMCS rate F-value increased from 5.429 to 10.261, and the Prob>F decreased from 0.0155 to 0.0016 indicating the model is useful at predicting the TNMCS rate at all three alpha significance levels including 0.01. The R-square indicates the model explains 73.67% of the total TNMCS rate variability as opposed to 59.69% previously.

TNMCM Rate Regression Model. Initially cancellation rate and cancellation rate squared were entered in the regression model but the global measures were degraded. Taking the first degree cancellation rate term out of the model and leaving the quadratic term improved the model global measures but failed to increase the usefulness of the model. The F-value increased from 5.922 to 8.173, and the Prob>F decreased from 0.0301 to 0.0134. The R-square value increased slightly from 0.3130 to 0.3860. The model continues to not be useful at 0.01 alpha significance.

Model Validation. The validation results computed by SAS for the six months validation data are presented in Appendix G.3. A summary is presented in Table 15 and should be referenced for the following discussion.

Five observations for MC rate are included in the 90% confidence intervals; April-July 1990 and September 1990. August 1990 is included in the 95% interval. The TNMCS rate validation results are similar. Five observations, April-August 1990 are included in the 90% confidence interval and September 1990 is in the 95% interval. TNMCM rate results show that April 1990 is included in the 95% confidence interval, May-July 1990 is in the 90% interval and August 1990 is in the 99% interval for the predicted value. Studying Table 15 and the SAS output in

TABLE 15

RC-135V/N VALIDATION RESULTS

	MC Rate		TNMCS Rate		TNMCM Rate	
Date	Actual	Pred.	Actual	Pred.	Actual	Pred.
Apr 90	59.7 *	[illegible]	[illegible] *	34.89	31.6 **	25.49
May 90	63.5 *	[illegible]	[illegible] *	25.65	26.3 *	23.97
Jun 90	58.6 *	[illegible]	[illegible] *	33.34	27.5 *	35.51
Jul 90	66.5 *	[illegible]	[illegible] *	18.75	27.5 *	24.38
Aug 90	80.5 **	[illegible]	[illegible] *	17.80	14.2 ***	24.14
Sep 90	66.7 *	67.[illegible]	[illegible] **	14.03	27.1 *	24.72

*   90% (0.10 alpha)
** 95% (0.05 alpha)
*** 99% (0.01 alpha)

Appendix G.3 indicates the apparent accuracy of the RC-135V/N models may be a mirage. The large random error present in the data has caused SAS to compute large intervals for some observations. The large intervals make the models appear relatively more accurate than actual.

EC-135A/C/G/L/N/Y

Correlation Analysis. The SAS correlation analysis output is presented in Appendix D.4. The correlation analysis results are summarized in Table 16 and should be referenced for the following discussion.

1. MC Rate. Aircraft break rate is negatively correlated with MC rate. An increase in aircraft break rate results from an increased number of aircraft breaks causing a loss of MC time waiting for parts or maintenance. When aircraft break rate increases MC rate decreases.

TABLE 16

EC-135A/C/G/L/N/Y CORRELATION ANALYSIS SUMMARY

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Aircraft Breaks	*	0.64179 0.0099	*
Aircraft Break Rate	-0.79694 0.0004	0.85050 0.0001	0.52126 0.0463
Cancellation Rate	*	*	0.52566 0.0442
Aircraft Hours Flown	0.67424 0.0058	-0.53333 0.0406	-0.65143 0.0085
Man-Hours Expended	0.78529 0.0005	-0.61695 0.0143	-0.55959 0.0301
Sorties Flown	0.70157 0.0036	-0.54377 0.0361	-0.61780 0.0141
Number Fixed in 18 Hours	-0.67129 0.0061	0.65039 0.0087	0.58603 0.0217

"*" Indicates correlation p-value greater than 0.05

Aircraft hours flown and sorties flown are highly correlated at 0.0001 significance level. These two maintenance constraints are collinear and provide similar information to determining MC rate. The MC rate is positively correlated with aircraft hours and sorties flown. This is consistent with findings for the KC-135A/D/E/Q aircraft and may be referenced for further understanding.

The MC rate is positively correlated with man-hours expended, that is as man-hours expended increases MC rate increases. This finding is

consistent with the correlation between man-hours expended and MC rate for the KC-135A/D/E/Q and may be referenced for further understanding.

The MC rate and number fixed in 18 hours is negatively correlated; as the number fixed in 18 hours increases MC rate decreases. This finding is unusual and not consistent with logical thought. When the number of aircraft fixed in 18 hours increases, more aircraft possessed time is spent in MC status because aircraft are fixed sooner which should increase MC rate. MC rate is correlated with an intervening maintenance constraint aircraft break rate. Aircraft break rate and number fixed in 18 hours is highly positive correlated at 0.0004 significance. MC rate is negatively correlated with number fixed in 18 hours because of the intervening maintenance constraint break rate; as break rate increases, the number fixed in 18 hours increases, and MC rate decreases due to increased aircraft breaks.

2. TNMCS Rate. Aircraft breaks and aircraft break rate are correlated significantly at 0.0002 and therefore are collinear providing similar information to determining TNMCS rate. Both maintenance constraints are positively correlated to TNMCS rate. As aircraft breaks and break rate increases TNMCS increases. This is consistent with the negative correlation between break rate and MC rate. When the number of aircraft breaks increases more aircraft possessed hours are accumulating NMC time. In this case, NMC time is chargeable to supply which means that aircraft are accumulating TNMCS time waiting for parts.

As is discussed for MC rate, aircraft hours flown and sorties flown are collinear and both constraints are negatively correlated to TNMCS rate. This is consistent with the findings for the MC rate correlation

with these constraints. The rationale given in the MC rate discussion is applicable with the exception of opposite correlation nature.

The TNMCS rate is negatively correlated with man-hours expended. As man-hours expended increases TNMCS rate decreases. This finding is consistent with TNMCS rate and man-hours expended correlation identified for the KC-135A/D/E/Q and may be referenced for further understanding.

The number fixed in 18 hours and TNMCS rate are positively correlated; as the number fixed in 18 hours increases TNMCS rate increases. The intervening maintenance constraint break rate causes the TNMCS rate to increase. The fact that TNMCS rate is increasing indicates a portion of aircraft breaks are due to material failure and the supply systems inability to immediately provide parts.

3. TNMCM Rate. The TNMCM rate is positively correlated with aircraft break rate. As aircraft break rate increases TNMCM rate increases. Increasing the number of aircraft breaks increases the aircraft accumulated NMC time.

Cancellation rate is positively correlated with TNMCM rate; as cancellation rate increases TNMCM rate increases. This would be the case for cancellations resulting from aircraft breaks rather than nonmaintenance conditions.

Aircraft hours flown and sorties flown are collinear providing similar information for determining TNMCM rate. These maintenance constraints are negatively correlated with TNMCM rate. As aircraft hours flown and sorties flown increases TNMCM rate decreases. The same rationale for aircraft hours and sorties flown correlation with MC rate applies to TNMCM rate with the exception of opposite correlation nature.

Man-hours expended is negatively correlated with TNMCM rate indicating that increasing man-hours expended decreases TNMCM rate. Again, this appears to support the idea that maintenance is labor intensive.

TNMCM rate is positively correlated with number of aircraft fixed in 18 hours, that is as number fixed in 18 hours increases TNMCM rate increases. The TNMCS rate rationale given for the intervening maintenance constraint break rate applies to TNMCM rate.

Stepwise Regression. The SAS stepwise regression output for the EC-135A/C/G/L/N/Y aircraft is presented in Appendix E.4. A summary appears in Table 17 and should be referenced for the following discussion.

MC Rate Regression Model. The model is useful for predicting MC rate at 0.10, 0.05, and 0.01 significance levels. The 15.10 F-value is greater than the F-Alpha values, and the 0.0003 Prob>F is less than the alpha significance levels. Cannibalization rate, aircraft hours flown, man-hours per sortie, number fixed in 18 hours explain 85.79% of the total MC rate variability.

Cannibalization rate and man-hours per sortie did not identify during correlation analysis although contribute positively to the model as indicated by positive parameter values. Aircraft hours flown identified during correlation analysis as being positively correlated with MC rate. The maintenance constraint increases the MC rate model value by virtue of the positive parameter.

The regression entered the number fixed in 18 hours which is consistent with the correlation findings that as the maintenance

TABLE 17

EC-135A/C/G/L/N/Y STEPWISE REGRESSION RESULTS

Mission Capable Rate

Model Form

MCR = - 77.815
+ 61.846(CNR)
+ 0.069(HFN)
+ 0.268(MHS)
- 0.218(NFH)

Rsquare	F-Value	Prob>F
0.85794	15.10	0.0003

Model Useful (F>F-Alpha)
F-Alpha Values

0.10	0.05	0.01
2.61	3.48	5.99

TNMCS Rate

Model Form

TNMCS = - 0.998
+ 0.532(ABR)

Rsquare	F-Value	Prob>F
0.72335	33.99	0.0001

Model Useful (F>F-Alpha)
F-Alpha Values

0.10	0.05	0.01
3.14	4.67	9.07

TNMCM Rate

Model Form

TNMCM = 36.667
- 0.023(HFN)
+ 0.277(NFH)

Rsquare	F-Value	Prob>F
0.61079	9.42	0.0035

Model Useful (F>F-Alpha)
F-Alpha Values

0.10	0.05	0.01
2.81	3.89	6.93

* Constraint parameters rounded to the third decimal position.

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constraint increases MC rate decreases. The intervening constraint break rate appears to best explain this observation.

TNMCS Rate Regression Model. The measures of interest indicate the model is useful for predicting TNMCS rate at 0.10, 0.05,

and 0.01 significance levels. The 33.99 F-value is greater than the F-Alpha values, and the 0.0001 Prob>F is less than the alpha significance levels. The R-square indicates that aircraft break rate explains 72.34% of the total TNMCS rate variability.

Aircraft break rate identified during correlation analysis significantly at 0.0001. This finding indicates aircraft break rate contributes significantly to determining TNMCM rate.

TNMCM Rate Regression Model. The regression model is useful for predicting TNMCM rate at 0.10, 0.05, and 0.01 significance levels. The 9.42 F-value is greater than the F-Alpha values, and the 0.0035 Prob>F is less than the alpha significance levels. Aircraft hours flown and number fixed in 18 hours explains 61.08% of the total TNMCM rate variability as indicated by the R-square value.

Aircraft hours flown and number fixed in 18 hours contribute to predicting TNMCM rate with aircraft hours flown subtracting from TNMCM rate and number fixed in 18 hours adding to TNMCM rate. This finding is consistent with the MC rate model where the MC rate model included aircraft hours flown and number fixed in 18 hours but with opposite parameter natures.

Residual Analysis. Residual analysis plots of all three model's predicted value and maintenance constraints were studied and appear to be random indicating the model cannot be improved using quadratic maintenance constraints.

Model Validation. The validation results computed by SAS for the six months validation data are presented in Appendix G.4. Reference the summary presented in Table 18 for the following discussion.

TABLE 18

EC-135A/C/G/L/N/Y VALIDATION RESULTS

	MC Rate		TNMCS Rate		TNMCM Rate	
Date	Actual	Pred.	Actual	Pred.	Actual	Pred.
Apr 90	59.3 *	55.61	20.7 ***	30.43	31.0 *	31.05
May 90	70.2 *	69.76	16.0 ***	22.40	23.0 *	24.04
Jun 90	71.6 *	63.29	16.2 *	15.22	20.7 *	21.06
Jul 90	66.3 **	56.53	16.3 *	19.10	23.8 *	25.99
Aug 90	74.1	36.31	17.0 *	15.97	17.1 **	28.73
Sep 90	76.0 ***	12.97	17.6 *	13.09	15.5 *	28.07

* 90% (0.10 alpha)
** 95% (0.05 alpha)
*** 99% (0.01 alpha)

The MC rate observations included in the 90% confidence intervals are April-June 1990, in the 95% interval is July 1990, and in the 99% interval is September 1990. August 1990 is not included in any of the three confidence intervals. The observations for the TNMCS rate included in the 90% confidence interval are June-September 1990, and April and May 1990 are in the 99% interval. The TNMCM rate validations included April-July 1990 and September 1990 in the 90% confidence intervals, and August 1990 is in the 95% interval. Examining Table 18 shows that some of the observations that are included in a confidence interval possess a large delta between the actual and predicted values.

E-4B

Correlation Analysis. The SAS correlation analysis output is presented in Appendix D.5. A summary of the correlation results is presented in Table 19 and should be referenced for the following discussion.

TABLE 19

E-4B CORRELATION ANALYSIS SUMMARY

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Possessed Aircraft	*	*	-0.52495 0.0445
Possessed Hours	*	*	-0.55553 0.0316

"*" Indicates correlation p-value greater than .05

1. TNMCM Rate. The MC and TNMCS rates failed to correlate with any maintenance constraints at 0.05 significance level. The TNMCM rate is negatively correlated with possessed aircraft and possessed hours; as one or both maintenance constraints increase TNMCM rate decreases. As possessed time increases percentage of NMC time decreases. This is initially presented in the discussion of MC rate correlation for the KC-135A/D/E/Q and can be reviewed for further understanding.

Stepwise Regression. The SAS forward stepwise regression output for the E-4B aircraft is presented in Appendix E.5. A summary of the regression results appears in Table 20 and should be referenced for the following discussion.

MC Rate Regression Model. The model is useful for predicting MC rate at 0.10 and 0.05 significance levels. The 5.22 F-value is greater than the F-Alpha values, and the 0.0156 Prob>F is less than the alpha significance levels. However, the model is not useful at 0.01 due to the F-value being less than the F-Alpha, and the Prob>F being greater

TABLE 20

E-4B STEPWISE REGRESSION RESULTS

Mission Capable Rate

Model Form	Rsquare	F-Value	Prob>F
	0.67619	5.22	0.0156

$$\begin{aligned} MCR = & - 9.708 \\ & + 11.597(ASD) \\ & - 0.001(MHE) \\ & + 0.953(SFN) \\ & + 0.208(AFR) \end{aligned}$$

Model Useful (F>F-Alpha)
F-Alpha Values

0.10	0.05	0.01
2.61	3.48	5.99

TNMCS Rate

Model Form	Rsquare	F-Value	Prob>F
	0.40410	4.08	0.0444

$$\begin{aligned} TNMCS = & - 8.970 \\ & + 0.447(LTR) \\ & + 0.185(MHF) \end{aligned}$$

Model Useful (F>F-Alpha)
F-Alpha Values

0.10	0.05	0.01
2.81	3.89	6.93

TNMCM Rate

Model Form	Rsquare	F-Value	Prob>F
	0.44769	4.86	0.0284

$$\begin{aligned} TNMCM = & \; 79.660 \\ & - 0.022(PSH) \\ & - 0.131(NFH) \end{aligned}$$

Model Useful (F>F-Alpha)
F-Alpha Values

0.10	0.05	0.01
2.81	3.89	6.93

* Constraint parameters rounded to the third decimal position.

than the alpha significance level. The R-square indicates average sortie duration, man-hours expended, sorties flown, and fix rate explain 67.62% of MC rate total variability.

Average sortie duration, sorties flown, and aircraft fix rate add to MC rate by virtue of positive parameter values. Man-hours expended, on the other hand, reduces MC rate by virtue of a negative parameter value. None of the four maintenance constraints identified during correlation analysis.

<u>TNMCS Rate Regression Model.</u> Late take-off rate and man-hours per flying hour contribute information to predicting TNMCS rate. The model is useful at 0.10 and 0.05 significance levels. The 4.08 F-value is greater than the F-Alpha values, and the 0.0444 Prob>F is less than the alpha significance levels. The model is not useful at 0.01 significance level where the F-value is less than the F-Alpha value, and the Prob>F is greater than the alpha significance level. The R-square indicates the maintenance constraints explain 40.50% of TNMCS rate total variability.

Late take-off rate and man-hours per flying hour possess positive parameters which adds to TNMCS rate. As either maintenance constraint increases, TNMCS rate increases. Neither constraint identified during correlation analysis.

<u>TNMCM Rate Regression Model.</u> The model is useful for predicting TNMCM rate at 0.10 and 0.05 significance levels. The 4.86 F-value is greater than the F-Alpha values, and the 0.0284 Prob>F is less than the alpha significance levels. Possessed hours and aircraft fix rate explain 44.77% of TNMCM rate total variability as indicated by the R-square value.

Possessed hours and aircraft fix rate reduces TNMCM rate by virtue of the negative parameter values. As either maintenance constraint increases TNMCM rate decreases. The two maintenance constraints

identified during correlation analysis when the nature of the relationship is also negative.

Residual Analysis. Residual analysis plots of all three model's predicted value and maintenance constraints were studied and appear to be random indicating the model cannot be improved further using the available maintenance constraints. No other configuration of variables will improve model performance.

Model Validation. The validation results computed by SAS for the six months validation data are presented in Appendix G.5. A summary is presented in Table 21 and should be referenced for the following discussion.

TABLE 21

E-4B VALIDATION RESULTS

	MC Rate		TNMCS Rate		TNMCM Rate	
Date	Actual	Pred.	Actual	Pred.	Actual	Pred.
Apr 90	75.1 ***	93.05	10.0 *	2.45	24.8 **	7.94
May 90	76.0 *	68.63	0.8 *	2.55	23.8 *	20.03
Jun 90	72.5 *	63.78	0.0 *	3.83	27.5 *	25.80
Jul 90	79.5 *	60.75	10.1 *	3.83	10.8 *	17.66
Aug 90	62.5 *	74.40	19.2 **	3.95	29.7 *	22.35
Sep 90	75.6 *	82.95	10.3 *	-2.23	24.4 *	17.28

* 90% (0.10 alpha)
** 95% (0.05 alpha)
*** 99% (0.01 alpha)

The MC rate for April 1990 is included in the 99% confidence interval, and the MC rate observations for May-September 1990 are included in the 90% interval. Five of the TNMCS rate observations,

April-July 1990 and September 1990 are included in the 90% confidence interval, and the observation for August 1990 is included in the 95% interval. The TNMCM rate observations for May-September 1990 are in the 90% confidence interval and April 1990 is included in the 95% interval. Note some of the deltas between the actual and predicted values are large. For Example, the TNMCS rate observation for September 1990 possesses a 12 point difference between actual and predicted values.

B-1B

Correlation Analysis. The B-1B SAS correlation analysis output is presented in Appendix D.6. A summary of the results is presented in Table 22 and should be referenced for the following discussion.

TABLE 22

B-1B CORRELATION ANALYSIS SUMMARY

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Aircraft Break Rate	*	*	0.53185 0.0413

"*" Indicates correlation p-value greater than 0.05

1. TNMCM Rate. There are no maintenance constraints that correlate with MC and TNMCS rate at 0.05 significance level. Aircraft break rate correlates positively with TNMCM rate. As aircraft break rate increases TNMCM rate increases. A similar discussion for this correlation is presented for the EC-135A/C/G/L/N/Y MC rate. As the

number of aircraft breaks increases more aircraft possessed time is spent as TNMCM time increasing TNMCM rate. The B-1B MC rate is not negatively correlated at 0.05 significance level as expected and as is the case with the EC-135 aircraft, although, the B-1B MC rate is negatively correlated at 0.0618.

Stepwise Regression. The SAS regression models for the B-1B aircraft are presented in Appendix E.6. The stepwise regression results are summarized in Table 23 and should be referenced for the following discussion.

MC Rate Regression Model. The MC rate regression model is useful for predicting MC rate at 0.10 and 0.05 significance levels. The 3.89 F-value is greater than the F-Alpha, and the 0.0371 Prob>F is less than the alpha significance levels. However, the F-value is less than the F-Alpha, and the Prob>F is greater than the alpha significance level indicating the model is not useful at 0.01 significance. The R-square indicates 60.86% of the total MC rate variability is explained by aircraft break rate, cancellations, late take-off rate, and number fixed in 18 hours. The model is not useful for predicting MC rate at 0.01 level of significance due to the F-value less than the F-Alpha, and the Prob>F is greater than the alpha significance level.

Aircraft break rate and cancellations reduce MC rate. The negative parameter causes MC rate to decrease when either of the maintenance constraints increase. However, when either late take-off rate or number fixed in 18 hours increases MC rate increases as a result of the constraint positive parameters. None of the four maintenance constraints identified during correlation analysis.

TABLE 23

B-1B STEPWISE REGRESSION RESULTS

Mission Capable Rate	Rsquare	F-Value	Prob>F
Model Form	0.60860	3.89	0.0371
MCR = 48.762 - 0.500(ABR) - 0.099(CNX) + 0.797(LTR) + 0.086(NFH)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	2.16	3.48	5.99
TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.16579	2.58	0.1320
TNMCS = 39.940 - 0.010(CAN)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	3.14	4.67	9.07
TNMCM Rate	Rsquare	F-Value	Prob>F
Model Form	0.28286	5.13	0.0413
TNMCM = 13.669 + 0.456(ABR)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	3.14	4.67	9.07

* Constraint parameters rounded to the third decimal position.

TNMCS Rate Regression Model. The TNMCM rate model is not useful at predicting TNMCS rate at 0.10, 0.05, and 0.01 significance. At all three significance levels, the F-value is less than the F-Alpha values, and the Prob>F is greater than the alpha significance levels.

In addition, the model explains only 16.58% of the total variability in TNMCS rate is explained by cannibalizations.

TNMCM Rate Regression Model. The TNMCM rate model is not useful for predicting TNMCM rate at 0.01 level of significance. The 5.13 F-value is less than the F-Alpha, and the 0.0413 Prob>F is greater than the alpha significance level. The model is useful at 0.10 and 0.05 level of significance. The F-value is greater than the F-Alpha values, and the Prob>F is less than the alpha significance levels. The R-square indicates that 28.29% of TNMCM rate variability is explained by aircraft break rate.

Residual Analysis. Residual plots were studied and indicate the models selected through stepwise regression cannot be improved by the addition of a quadratic maintenance constraint term.

Model Validation. The validation results computed by SAS for the six months validation data are presented in Appendix G.6. A summary of the results is presented in Table 24 and should be referenced for the following discussion.

The MC rate 90% confidence interval includes observations for June 1990 and August-September 1990, and the 99% interval includes July 1990. April-May 1990 are not included in any of the intervals. The TNMCS rate September 1990 observation is included in the 99% confidence interval, but April 1990 through August 1990 are not included in any one of the three intervals. The TNMCM rate observations for April 1990 and June-September 1990 are in the 90% confidence interval, and May 1990 is in the 99% interval.

TABLE 24

B-1B VALIDATION RESULTS

	MC Rate		TNMCS Rate		TNMCM Rate	
Date	Actual	Pred.	Actual	Pred.	Actual	Pred.
Apr 90	59.2	51.48	28.6	36.62	24.1 *	27.26
May 90	62.2	49.53	26.3	36.12	19.5 ***	28.81
Jun 90	56.3 *	55.47	29.6	36.02	25.6 *	26.35
Jul 90	59.0 ***	52.21	28.7	37.62	22.1 *	27.81
Aug 90	56.7 *	53.55	30.1	35.94	22.9 *	28.63
Sep 90	57.9 *	53.92	30.8 ***	35.51	20.6 *	25.35

* 90% (0.10 alpha)
** 95% (0.05 alpha)
*** 99% (0.01 alpha)

B-52H

Correlation Analysis. The SAS correlation analysis output products are presented in Appendix D.7. A summary of the correlation analysis is presented in Table 25 and should be referenced for the following discussion.

TABLE 25

B-52H CORRELATION ANALYSIS SUMMARY

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Aircraft Fix Rate	0.58944 0.0208	-0.54256 0.0366	*

"*" Indicates correlation p-value greater than 0.05

1. MC Rate. Aircraft fix rate is positively correlated with MC rate at 0.05 significance level. As the aircraft fix rate increases MC rate increases. An increase in aircraft fix rate indicates that more aircraft breaks are fixed in the first 18 hours after landing. Which also indicates as the aircraft fix rate increases more possessed time is spent as MC time.

2. TNMCS Rate. Aircraft fix rate is negatively correlated to TNMCS rate. As aircraft fix rate increases TNMCS rate decreases. This indicates the supply systems ability to quickly deliver parts decreases the amount of time an aircraft spends NMC.

Stepwise Regression. The SAS stepwise regression output is presented in Appendix E.7. The regression results are summarized in Table 26 for the three production output measures.

MC Rate Regression Model. At 0.10 and 0.05 significance levels, the model appears useful for predicting MC rate. The 6.92 F-value is greater than the F-Alpha values as well as the 0.0208 Prob>F is less than the alpha significance levels. The R-square indicates aircraft fix rate explains 34.74% of the total MC rate variability. The model is not useful at 0.01. The F-value is less than F-Alpha, and Prob>F is greater than the alpha level.

Aircraft fix rate is entered in the model as a positive parameter which indicates MC rate increases as aircraft fix rate increases. This is consistent with correlation analysis findings presented earlier.

TNMCS Rate Regression Model. The TNMCS rate model is useful at 0.10 and 0.05 significance levels. The 5.96 F-value is greater than the F-Alpha values, and the 0.0115 Prob>F is less than the alpha significance levels. Late take-offs, man-hours expended and aircraft

TABLE 26

B-52H STEPWISE REGRESSION RESULTS

	Rsquare	F-Value	Prob>F
Mission Capable Rate			
Model Form	0.34744	6.92	0.0208
MCR = 59.666 + 0.252(AFR)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	3.14	4.67	9.07
TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.61927	5.96	0.0115
TNMCS = 51.698 − 0.096(LTO) − 0.00007(MHE) − 0.356(AFR)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	2.66	3.59	6.22
TNMCM Rate	Rsquare	F-Value	Prob>F
Model Form	0.17855	2.83	0.1166
TNMCM = 15.864 + 0.109(CNX)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	3.14	4.67	9.07

* Constraint parameters rounded to the third decimal position (exception: The TNMCS model MHE constraint).

fix rate explain 61.93% of the total TNMCS rate variability. The TNMCS rate model is not useful at the 0.01 significance level. The F-value is less than F-Alpha, and Prob>F is greater than alpha significance level.

Three maintenance constraints late take-offs, man-hours expended and aircraft fix rate are entered in the model. All three maintenance constraints possess negative parameters which subtract from TNMCS rate. As late take-offs increase TNMCS rate decreases. This finding is not consistent with MC rate correlation analysis found for the KC-135R aircraft. For the KC-135R, the MC rate is negatively correlated to late take-off rate. For the findings to be consistent, the B-52H TNMCS rate would be positively correlated to the late take-off rate. The man-hours expended and aircraft fix rate negative parameters are consistent with previous findings for other aircraft.

TNMCM Rate Regression Model. The TNMCM rate model is not useful for predicting TNMCM rate at all three significance levels. The 2.83 F-value is less than the F-Alpha values, and the 0.1166 Prob>F is greater than alpha significance levels. The R-square indicates cancellations only explain 17.86% of the total TNMCM rate variability.

Residual Analysis. Residual plots were studied and indicate the models cannot be improved through the use of a quadratic maintenance constraint term. None of the plots indicate a curvature in the residual data.

Model Validation. The validation results computed by SAS for the six months validation data are presented in Appendix G.7. A summary of the results is presented in Table 27.

The MC rate 90% confidence interval includes all observations April-September 1990. The TNMCS rate observations for April-July 1990 are included in the 90% confidence interval, and the August and September 1990 observations are in the 99% and 95% confidence intervals respectively. The TNMCM rate observations for April 1990 and

TABLE 27

B-52H VALIDATION RESULTS

	MC Rate		TNMCS Rate		TNMCM Rate	
Date	Actual	Pred.	Actual	Pred.	Actual	Pred.
Apr 90	79.2 *	79.13	11.4 *	9.24	16.6 *	17.07
May 90	82.0 *	79.26	9.3 *	10.49	14.4 **	17.40
Jun 90	80.9 *	80.77	8.5 *	9.20	16.6 *	17.51
Jul 90	78.6 *	79.13	11.4 *	11.32	17.5 *	17.18
Aug 90	76.7 *	75.58	11.9 ***	15.99	17.4 *	17.94
Sep 90	81.8 *	79.12	10.5 **	14.85	14.3 *	16.63

* 90% (0.10 alpha)
** 95% (0.05 alpha)
*** 99% (0.01 alpha)

June-September 1990 are in the 90% confidence interval, and May 1990 is in the 95% interval.

B-52G

Correlation Analysis. The SAS correlation analysis output products are presented in Appendix D.8. The correlation results summarized in Tables 28 and 29 should be referenced for the following discussion.

1. MC Rate. Aircraft breaks and aircraft break rate are positively correlated at 0.0001 significance level which indicates the maintenance constraints are collinear providing similar information to MC rate. The aircraft breaks and break rate are negatively correlated to MC rate. As the number of aircraft breaks and break rate increases MC rate decreases. As discussed previously for the EC-135, aircraft breaks and break rate increases causing more aircraft to require maintenance or parts therefore spending less possessed time as MC time.

TABLE 28

B-52G CORRELATION ANALYSIS SUMMARY

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Aircraft Breaks	-0.62154 0.0134	0.54167 0.0370	0.86276 0.0001
Aircraft Break Rate	-0.68314 0.0050	0.60517 0.0168	0.84462 0.0001
Aircraft Sortie Utilization Rate	*	*	0.59652 0.0189
Average Sortie Duration	*	*	0.61652 0.0144
Cannibalizations	-0.53102 0.0417	0.64310 0.0097	*
Cannibalization Rate	*	0.57829 0.0239	*
Aircraft Hours Flown	*	*	0.84488 0.0001
Late Take-Offs	-0.62215 0.0133	0.54537 0.0355	*
Man-Hours Expended	-0.61074 0.0156	0.60139 0.0177	0.72716 0.0021
Possessed Aircraft	*	0.59668 0.0189	*
Possessed Hours	*	0.54530 0.0355	0.53198 0.0412

"*" Indicates correlation p-value greater than 0.05

TABLE 29

B-52G CORRELATION ANALYSIS SUMMARY (continued)

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Sorties Attempted	*	*	0.72069 0.0024
Sorties Flown	*	*	0.73837 0.0017
Sorties Scheduled	*	*	0.69945 0.0037
Aircraft Fix Rate	0.57237 0.0250	-0.54190 0.0369	*
Number Fixed in 18 Hours	*	*	0.79853 0.0004

"*" Indicates correlation p-value greater than 0.05

The number of cannibalizations is negatively correlated to MC rate. The finding suggests as the number of cannibalizations increase MC rate decreases. Cannibalizations result from the inability of supply system to deliver parts in time to meet mission requirements. Assuming a designated aircraft is used for cannibalizations, cannibalizing to fix broken aircraft intuitively should improve MC rate. The negative correlation may be due to the aircraft condition requiring cannibalizations not the result of cannibalization. Cannibalization results from aircraft that are already broken and spent time NMC. As more aircraft breaks occur and cannot be supported by the supply system,

more NMC time is accumulated before the cannibalization action occurs thereby decreasing MC rate.

The number of late take-offs is negatively correlated to MC rate. This is consistent with findings for the KC-135A/D/E/Q aircraft and may be reviewed for further understanding.

The MC rate is negatively correlated with man-hours expended. As man-hours expended increases MC rate decreases. This finding is not consistent with the KC-135A/D/E/Q; the relationship nature is opposite. This finding would appear counter intuitive as confirmed by previous findings. Man-hours expended is highly positively correlated with aircraft breaks at 0.0006. Aircraft breaks appears to be an intervening maintenance constraint in the correlation between man-hours expended and MC rate. As the number of aircraft breaks increases MC rate decreases, and concurrently the man-hours expended will increase to fix broken aircraft. Thus, as man-hours increase MC rate decreases due to aircraft breaks.

The aircraft fix rate is positively correlated to MC rate. This finding is consistent with findings for the KC-135A/D/E/Q and B-52H aircraft. These findings may be reviewed for further understanding.

2. <u>TNMCS Rate.</u> As discussed previously for MC rate, aircraft breaks and aircraft break rate are highly positively correlated at a significance level of 0.0001 which indicates the maintenance constraints are collinear providing similar information to MC rate. The number of aircraft breaks is positively correlated to TNMCS rate which is consistent with findings for the EC-135 aircraft.

Number of cannibalizations and cannibalization rate are positively correlated with TNMCS rate. As cannibalizations and cannibalization

rate increases TNMCS rate increases. Cannibalizations and cannibalization rate are highly correlated at a significance of 0.0001 indicating the maintenance constraints are collinear and providing similar information to the correlation with TNMCS rate. An increased number of cannibalizations would be in response to an increased number of aircraft breaks requiring parts that the supply system cannot provide. As this situation occurs more aircraft breaks are due to supply thereby increasing TNMCS time. The cannibalizations occur after NMC time has accumulated and TNMCS time has increased.

The TNMCS rate is positively correlated with number of late take-offs. As late take-offs increase TNMCS rate increases. If a large proportion of late take-offs are due to aircraft breaks requiring supply support, then this correlation is correct.

Man-hours expended is positively correlated with TNMCS rate. This finding is not consistent with findings for the KC-135A/D/E/Q and EC-135 aircraft but is opposite in nature. The same rationale given for the MC rate findings applies with the exception that the intervening constraint aircraft breaks causes an increase in TNMCS rate due to an increase in parts required.

TNMCS rate is positively correlated with number of possessed aircraft and possessed hours, that is as possessed aircraft and possessed hours increases TNMCS rate increases. The possessed aircraft and hours are highly correlated at 0.0001 indicating the maintenance constraints provide similar information to TNMCS rate. The positive correlation between TNMCS rate and these two maintenance constraints is not consistent with the findings for the KC-135A/D/E/Q aircraft but is opposite in nature. Recall that in the KC-135A/D/E/Q discussion the

findings appeared inconsistent with the MC rate ratio. With possessed hours being the denominator in the MC rate ratio, it would appear the correlation should be negative. As the denominator increases the rate should decrease. The proposed rationale for the finding stated the apparent relationship would not be true if a greater percentage of the increased possessed time is MC time rather than NMC time. As possessed time increases the percentage of MC time also increases. Obviously, the B-52G finding is consistent with the TNMCS rate ratio, and the difference may be the result of the B-52G's more complex weapon systems and dependence on spare parts relative to the KC-135A/D/E/Q.

Aircraft fix rate is negatively correlated with the TNMCS rate, that is as aircraft fix rate increases TNMCS rate decreases. This is consistent with findings for the KC-135A/D/E/Q and B-52H aircraft, and these aircraft may be reviewed for further understanding.

3. TNMCM Rate. The number of aircraft breaks and aircraft break rate are highly correlated at 0.0001 indicating the two constraints provide similar information to TNMCM rate. The aircraft breaks and TNMCM rate are positively correlated and is consistent with findings for the EC-135 and B-1B aircraft. These aircraft may be reviewed for further understanding.

TNMCM rate is positively correlated with aircraft sortie utilization rate, aircraft hours flown, sorties attempted, sorties flown, and sorties scheduled which are highly correlated with one another. As any one of these five maintenance constraints increase TNMCM rate increases. The TNMCM rate positive correlation with aircraft hours flown is opposite to findings for the KC-135A/D/E/Q and EC-135, and the correlation between the TNMCM rate and sorties flown is opposite

in nature to findings for the EC-135. The findings for the B-52G would suggest the aircraft's break rate (mean value = 36.53) is higher than the KC-135A/D/E/Q (mean value = 6.27) and EC-135 (mean value = 35.71) causing more breaks and associated TNMCM time relative to the other two aircraft. This idea is supported in the case of the KC-135A/D/E/Q but only marginally with the EC-135. The increase in B-52G sorties or hours flown, represented by the five constraint measures above, leads to increased aircraft breaks and associated TNMCM time.

Average sortie duration is positively correlated with TNMCM rate, that is as average sortie duration increases TNMCM rate increases. This finding is consistent with the KC-135R and may be reviewed for further understanding.

TNMCM rate is positively correlated with number of man-hours expended. As man-hours expended increases TNMCM rate increases. This is not consistent with findings for the KC-135A/D/E/Q and EC-135 aircraft. The rationale for the positive correlation between TNMCM rate and man-hours expended is the same as for the MC rate with reference to the intervening constraint aircraft breaks.

Possessed hours is positively correlated to TNMCM rate, that is as possessed hours increases TNMCM rate increases. This is not consistent with findings for the KC-135A/D/E/Q and E-4B aircraft but is opposite in nature. The rationale given for correlation in the TNMCS rate discussion is similar here except the B-52G is maintenance intensive relative to the other two aircraft. The mean break rate for the KC-135A/D/E/Q, E-4B and B-52G is 6.27, 18.00, and 36.53 respectively.

The number fixed in 18 hours is positively correlated with TNMCM rate. This finding is consistent with that found for the EC-135 that as

number fixed in 18 hours increases TNMCM rate increases. Reference the EC-135 discussion for further understanding.

Stepwise Regression. The SAS forward stepwise regression outputs are presented in Appendix E.8. A summary of results is presented in Table 30 and should be referenced for the following discussion.

MC Rate Regression Model. The measures of interest indicate the model is useful at all three alpha values. The 8.47 F-value is greater than the F-Alpha values, and the 0.0051 Prob>F is less than the alpha significance levels. Although the measures indicate the model is useful, only 58.53 percent of MC rate variability is explained by the constraints; aircraft break rate and aircraft fix rate.

Aircraft break rate and aircraft fix rate are entered into the model with negative and positive parameters respectively. This supports the correlation analysis which identified that aircraft break rate decreases MC rate and aircraft fix rate increases MC rate.

TNMCS Rate Regression Model. The 9.17 F-value is greater than the F-Alpha values, and the 0.0097 Prob>F is less than the alpha significance levels. The model is useful at predicting the TNMCS rate using the maintenance constraint cannibalizations. The R-square is relatively low indicating only 41.39 percent of the total TNMCS rate variability is explained by cannibalizations.

Cannibalizations is entered into the model with a positive parameter. This is consistent with correlation analysis. As cannibalizations increase TNMCS rate increases.

TNMCM Rate Regression Model. The TNMCM rate model measures of interest are significant and indicate the model is useful for all three alphas selected. The 20.98 F-value is significantly greater than the

TABLE 30

B-52G STEPWISE REGRESSION RESULTS

Mission Capable Rate	Rsquare	F-Value	Prob>F
Model Form	0.58525	8.47	0.0051
MCR = 72.669 - 0.219(ABR) + 0.175(AFR)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	2.81	3.89	6.93

TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.41358	9.17	0.0097
TNMCS = 6.481 + 0.024(CAN)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	3.14	4.67	9.07

TNMCM Rate	Rsquare	F-Value	Prob>F
Model Form	0.85123	20.98	0.0001
TNMCM = 3.925 + 0.031(ABK) + 1.260(ASD) - 0.022(NFH)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	2.66	3.59	6.22

* Constraint parameters rounded to the third decimal position.

F-Alpha values, and the 0.0001 Prob>F is less than the alpha significance levels. The R-square shows that 85.12 percent of total TNMCM rate variability is explained by the model.

Aircraft breaks, average sortie duration, and the number fixed in 18 hours are entered in the model as maintenance constraints that explain the occurrence of TNMCM rate. The positive relationship between TNMCM rate and aircraft breaks and average sortie duration is consistent with the correlation findings. The number fixed in 18 hours negative parameter is not consistent with the correlation and subtracts from the TNMCM rate in the regression model.

Residual Analysis. Residual plots were studied and indicate the models cannot be improved through the use of a quadratic maintenance constraint term. None of the residual plots indicate a curvature in residual data which would indicate the need for a quadratic term.

Model Validation. The validation results computed by SAS for the six months validation data are presented in Appendix G.8. A summary of the results is presented in Table 31 and should be referenced for the following discussion.

TABLE 31

B-52G VALIDATION RESULTS

	MC Rate		TNMCS Rate		TNMCM Rate	
Date	Actual	Pred.	Actual	Pred.	Actual	Pred.
Apr 90	81.1 *	79.50	10.0 *	11.17	13.7 ***	15.34
May 90	77.4 *	78.44	12.6 *	11.84	16.9 *	16.40
Jun 90	79.2 *	80.16	11.5 *	10.76	16.3 ***	14.74
Jul 90	79.0 *	78.19	11.0 *	10.09	15.1 *	14.93
Aug 90	81.4	75.73	9.3 *	10.35	13.0	16.17
Sep 90	77.6 *	75.70	12.8 *	11.76	15.3 *	15.26

* 90% (0.10 alpha)
** 95% (0.05 alpha)
*** 99% (0.01 alpha)

The MC rate 90% confidence interval included observations April-July and September 1990. August 1990 is not included in any confidence interval. The TNMCS rate for observations April-September 1990 are included in the 90% confidence interval. The TNMCM rate observations for May 1990, July 1990 and September 1990 are included in the 90% confidence interval, and April and June 1990 are included in the 99% interval. August 1990 is excluded from the intervals.

FB-111A

Correlation Analysis. The SAS correlation analysis output is presented in Appendix D.9. The correlation results are summarized in Table 32 and should be referenced for the following discussion.

TABLE 32

FB-111A CORRELATION ANALYSIS SUMMARY

INDEPENDENT VARIABLE	DEPENDENT VARIABLE		
	MC Rate	TNMCS Rate	TNMCM Rate
Cancellations	-0.81031 0.0002	*	0.64527 0.0094
Cancellation Rate	-0.83483 0.0001	*	0.67742 0.0055
Sorties Attempted	*	*	-0.51568 0.0491

"*" Indicates correlation p-value greater than 0.05

1. MC Rate. Cancellations and cancellation rate are highly correlated at 0.0001 level of significance. This indicates the two

maintenance constraints are collinear providing similar information to MC rate. MC rate is negatively correlated with number of cancellations and cancellation rate. As number of cancellations and cancellation rate increases MC rate decreases. This is consistent with findings for the KC-135R aircraft and may be reviewed for further understanding.

2. TNMCM Rate. Cancellations and cancellation rate are positively correlated with TNMCM rate. As cancellations and cancellation rate increases TNMCM rate increases. This finding is consistent with the KC-135R correlation.

Sorties attempted is negatively correlated with TNMCM rate, that is as sorties attempted increases TNMCM rate decreases. This finding is not consistent with findings for the B-52G but is opposite in nature. For the FB-111A, as TNMCM rate increases more aircraft are available for missions and is reflected in a greater utilization rate.

Stepwise Regression. The SAS forward stepwise regression output is presented in Appendix E.9. A summary of the findings is presented in Table 33 and should be referenced for the following discussion.

MC Rate Regression Model. The measures of interest indicate the model is useful at all three alpha values selected. The 19.55 F-value is greater than the F-Alpha values, and the 0.0001 Prob>F is less than the alpha significance levels. The R-square indicates that 88.66 percent of MC rate variability is explained by the constraints; cancellation rate, man-hours per flying hour, possessed aircraft and possessed hours.

The nature of the parameters indicate cancellation rate, man-hours per flying hour and possessed aircraft reduce MC rate while possessed

TABLE 33

FB-111A STEPWISE REGRESSION RESULTS

Mission Capable Rate	Rsquare	F-Value	Prob>F
Model Form	0.88663	19.55	0.0001
MCR = 85.263 − 1.070(CXR) − 0.094(MHF) − 0.823(PSA) + 0.001(PSH)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	2.61	3.48	5.99
TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.21753	3.61	0.0797
TNMCS = 21.872 − 0.115(AFR)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	3.14	4.67	9.07
TNMCM Rate	Rsquare	F-Value	Prob>F
Model Form	0.86352	8.44	0.0041
TNMCM = − 4.083 + 3.592(AAR) − 3.145(ASD) − 1.285(CNX) + 4.871(CXR) − 0.058(SAT) + 0.122(SSD)	Model Useful (F>F-Alpha) F-Alpha Value		
	0.10	0.05	0.01
	2.67	3.58	6.37

* Constraint parameters rounded to the third decimal position.

hours increases MC rate. Man-hours per flying hour, possessed aircraft and possessed hours failed to identify during correlation analysis.

TNMCS Rate Regression Model. The model is useful at alpha value 0.10 but not at alpha values 0.05 and 0.01. The 3.61 F-value is

greater than the 3.14 F-Alpha, and the 0.0797 Prob>F is less than the 0.10 alpha significance level. The F-value is less than the F-Alpha values, and the Prob>F is greater than the alpha significance levels at 0.05 and 0.01. The R-square indicates aircraft fix rate explains 21.75 percent of the total TNMCS rate variability.

The aircraft fix rate's negative parameter suggests the constraint reduces TNMCS rate as the constraint increases. This is logically correct; as more aircraft breaks are fixed in the first 18 hours the less time aircraft accumulates NMC time reducing TNMCS rate.

<u>TNMCM Rate Regression Model.</u> The measures of interest indicate this model is useful at the three alpha values selected. The 8.44 F-value is greater than the F-Alpha values, and the 0.0041 Prob>F is less than the alpha significance levels. The R-square indicates that 86.35% of the total TNMCM rate variability is explained by constraints; air abort rate, average sortie duration, cancellations, cancellation rate, sorties attempted and sorties scheduled.

Of the maintenance constraints entered into the model, the only constraints identified during correlation analysis were cancellations, cancellation rate, and sorties attempted. The nature of the correlations agree with the model constraint parameters for cancellation rate and sorties attempted. The cancellations parameter nature in the model is opposite that identified during correlation. Average sortie duration, cancellations, and sorties attempted reduce the model TNMCM rate while air aborts, cancellation rate, and sorties scheduled increase TNMCM rate.

<u>Residual Analysis.</u> The SAS residual analysis output is presented in Appendix F.9. The residual analysis findings indicate the TNMCS rate

model aircraft fix rate residual plot is curved. The model can be improved through the use of a quadratic aircraft fix rate term. A summary of the modified regression model is presented in Table 34.

TABLE 34

FB-111A STEPWISE REGRESSION
RESIDUAL MODIFICATIONS

TNMCS Rate	Rsquare	F-Value	Prob>F
Model Form	0.6262	10.05	0.0027
TNMCS = 154.404 − 3.544(AFR) + 0.022(SQAFR)	Model Useful (F>F-Alpha) F-Alpha Values		
	0.10	0.05	0.01
	2.81	3.89	6.93

* Constraint parameters rounded to the third decimal position.

The quadratic term improves the model's usefulness to now include 0.05 and 0.01 significance levels. The F-value increased to 10.05 and the Prob>F decreased to 0.0027 improving the model's usefulness at the significance levels indicated. The R-square improved indicating the modified model explains 62.62% of TNMCS rate total variability. The modified TNMCS rate model will be used in validation.

Model Validation. The validation results computed by SAS for the six months validation data are presented in Appendix G.9. A summary of the results is presented in Table 35 and should be referenced for the following discussion.

The MC rate 90% confidence interval includes observations for April and May 1990 and July-September 1990. June 1990 is included in the 99%

TABLE 35

FB-111A VALIDATION RESULTS

	MC Rate		TNMCS Rate		TNMCM Rate	
Date	Actual	Pred.	Actual	Pred.	Actual	Pred.
Apr 90	74.4 *	75.93	16.2	12.03	16.6 **	12.79
May 90	78.2 *	78.21	13.2 *	12.85	12.5 *	11.67
Jun 90	76.0 ***	80.09	15.3 ***	12.34	14.3 *	11.75
Jul 90	75.1 *	77.98	13.7 *	11.97	14.2 *	13.64
Aug 90	78.3 *	81.97	11.1 *	12.09	12.9 *	3.84
Sep 90	77.4 *	77.35	12.1 *	13.54	15.2 *	-0.52

* 90% (0.10 alpha)
** 95% (0.05 alpha)
*** 99% (0.01 alpha)

confidence interval. The TNMCS rate for observations May 1990 and July-September 1990 are included in the 90% confidence interval. June 1990 is included in the 99% interval, and April 1990 is excluded from the intervals. The TNMCM rate observations for May-September 1990 are in the 90% confidence interval, and April 1990 is in the 95% interval.

Aggregated Aircraft Data

The findings to this point are segregated by aircraft, and inferences made about individual aircraft cannot be applied to the general case. So, it is important to aggregate the findings to identify maintenance constraints commonalities for the three production output measures that may be applied to the aircraft maintenance general case. Tables 36, 38, and 40 includes those maintenance constraints identified during correlation analysis for MC, TNMCS, and TNMCM rate respectively. Tables 37, 39, and 41 identifies constraints by aircraft included in the MC, TNMCS, and TNMCM rate regression models respectively.

TABLE 36

MAINTENANCE CONSTRAINTS AGGREGATED FOR MC RATE CORRELATION ANALYSIS

Aircraft	Maintenance Constraints							
	ABK	ABR	AFR	ASD	CAN	CNX	CXR	HFN
KC-135			+					+
KC-135R				–		–	–	
RC-135								
EC-135		–						+
E-4B								
B-1B								
B-52H			+					
B-52G	–	–	+	–				
FB-111A						–	–	

Aircraft	LTO	MHE	NFH	PSA	PSH	SAT	SFN	SSD
KC-135		+		+	+	+	+	+
KC-135R	–							
RC-135								
EC-135		+	–				+	
E-4B								
B-1B								
B-52H								
B-52G	–	–						
FB-111A								

TABLE 37

MAINTENANCE CONSTRAINTS AGGREGATED FOR MC RATE REGRESSION MODEL

Aircraft	Maintenance Constraints								
	AAB	ABR	AFR	ASD	CNX	CXR	CAN	CNR	HFN
KC-135			+			+			+
KC-135R	–	+				–	+		
RC-135									
EC-135								+	+
E-4B			+	+					
B-1B		–			–				
B-52H			+						
B-52G		–	+						
FB-111A						–			
	LTO	LTR	MHE	MHS	MHF	NFH	PSA	PSH	SFN
KC-135	–			–			+		
KC-135R									
RC-135								+	
EC-135				+		–			
E-4B			–						+
B-1B		+				+			
B-52H									
B-52G									
FB-111A					–		–	+	

TABLE 38

MAINTENANCE CONSTRAINTS AGGREGATED FOR TNMCS RATE CORRELATION ANALYSIS

Aircraft	Maintenance Constraints							
	ABK	ABR	AFR	CAN	CNR	CNX	CXR	HFN
KC-135			–					–
KC-135R						+	+	
RC-135								
EC-135	+	+						–
E-4B								
B-1B								
B-52H			–					
B-52G	+	+	–	+	+			
FB-111A								

Aircraft	LTO	MHE	NFH	PSA	PSH	SAT	SFN	SSD
KC-135		–		–	–	–	–	–
KC-135R								
RC-135					–			
EC-135		–	+				–	
E-4B								
B-1B								
B-52H								
B-52G	+	+		+	+			
FB-111A								

TABLE 39

MAINTENANCE CONSTRAINTS AGGREGATED FOR TNMCS RATE REGRESSION MODEL

Aircraft	Maintenance Constraints						
	ABR	AFR	ASD	CXR	CAN	CNR	LTO
KC-135		-	-				
KC-135R		+		+	-		
RC-135	+					+	
EC-135	+						
E-4B							
B-1B					-		
B-52H		-					-
B-52G					+		
FB-111A		-					

Aircraft	LTR	MHE	MHF	PSA	PSH	SSD
KC-135				-	+	-
KC-135R			+			
RC-135					-	
EC-135						
E-4B	+		+			
B-1B						
B-52H		-				
B-52G						
FB-111A						

TABLE 40

MAINTENANCE CONSTRAINTS AGGREGATED FOR TNMCM RATE CORRELATION ANALYSIS

Aircraft	Maintenance Constraints							
	ABK	ABR	AFR	ASU	ASD	CNX	CXR	HFN
KC-135			−					
KC-135R					+	+	+	
RC-135							+	
EC-135		+					+	−
E-4B								
B-1B		+						
B-52H								
B-52G	+	+		+	+			+
FB-111A						+	+	

	MHE	NFH	PSA	PSH	SAT	SFN	SSD
KC-135			−	−			
KC-135R							
RC-135							
EC-135	−	+				−	
E-4B			−	−			
B-1B							
B-52H							
B-52G	+	+		+	+	+	+
FB-111A					−		

TABLE 41

MAINTENANCE CONSTRAINTS AGGREGATED FOR TNMCM RATE REGRESSION MODEL

Aircraft	Maintenance Constraints							
	AAB	AAR	ABK	ABR	ASD	AFR	CNX	CXR
KC-135						–	–	
KC-135R	+			–				+
RC-135								+
EC-135								
E-4B								
B-1B				+				
B-52H							+	
B-52G			+		+			
FB-111A		+			–		–	+

Aircraft	CAN	HFN	MHF	NFH	PSA	PSH	SAT	SSD
KC-135			+		–			
KC-135R	–							
RC-135								
EC-135		–		+				
E-4B				–		–		
B-1B								
B-52H								
B-52G				–				
FB-111A							–	+

MC Rate. Generally, the data indicates a lack of consistency across the nine aircraft, although one maintenance constraint appears prominent. Aircraft fix rate identified during correlation analysis for the KC-135A/D/E/Q, B-52H, and B-52G aircraft and again during regression modelling for the same three aircraft plus the E-4B. It appears for MC rate, aircraft fix rate is an important maintenance constraint that explains MC rate at least in the aircraft cited though possibly not to the general case.

TNMCS Rate. Aircraft fix rate identified three times during correlation analysis. Once each for the KC-135A/D/E/Q, B-52H, and B-52G aircraft. The regression models for the same aircraft with the addition of the KC-135R included aircraft fix rate in the regression equation. Again, though the data does not conclusively indicate aircraft fix rate's generalizability to aircraft maintenance, the maintenance constraint is prominent and shows to be a good indication of the TNMCS rate at least for the aircraft cited.

TNMCM Rate. Aircraft fix rate does not appear prominent for the TNMCM rate production measure. Cancellation rate appears prominent for this data set. The correlation analysis for the nine aircraft identified the KC-135R, RC-135, EC-135, and FB-111A aircraft as sharing cancellation rate as a common maintenance constraint. The regression modelling results show the same aircraft except the EC-135 sharing the constraint. Once again, the results are not generalizable to aircraft maintenance but do indicate cancellation rate is important to explaining TNMCM rate.

Summary

This chapter presented answers to the research questions and the problem statement. The answer to research question 1 indicated many performance measures exist and are available for maintenance manager's use. Next, aircraft statistical analysis and regression modelling results were presented to answer research questions 2, 3 and 4. All nine aircraft were discussed individually giving correlation analysis and regression modelling results.

A table identifying the maintenance constraint and production output measure correlation with appropriate discussion was presented to answer questions 2 and 3 as to which constraints limit or enhance production capability and their statistical relationship.

In addition, twenty seven regression models were built using forward stepwise regression, and four additional models were built using residual analysis introducing quadratic terms where appropriate.

Finally, regression model validation results were presented with 90%, 95%, and 99% confidence intervals for the predicted value using the six months validation data. Following the discussion of all nine individual aircraft, commonalities between aircraft were presented.

V. Conclusions and Recommendations

Introduction

This chapter presents conclusions and recommendations resulting from the research effort conducted to identify maintenance constraint indicators of production capability which could be used in a regression model as predictors of maintenance production output. Additionally, suggested future research is presented at the end of the chapter.

Conclusions

The conclusions are presented following a restatement of the research questions presented in Chapter I.

1. What are the existing measures of aircraft maintenance production capability in SAC? The production measures presented in Appendix C are extracted from a spreadsheet currently used by HQ SAC/LGY to measure aircraft system and maintenance performance and from SACP 66-17. Some measures that appear in SACP 66-17 do not appear in the HQ SAC/LGY spreadsheet and visa versa. The list in Appendix C is a compilation of both sources.

2. What are the aircraft maintenance production constraints that limit or enhance production capability? The research data fails to conclusively identify any maintenance constraint measures that limit or enhance production capability that can be used for all nine SAC aircraft analyzed. The only indication of commonality is across four aircraft for only two maintenance constraints. The remaining maintenance constraints identified sporadically across the nine aircraft indicate an absolute lack of commonality. Though aircraft fix rate and cancellation

rate appears prominent for MC and TNMCS rate and TNMCM rate respectively, the finding cannot be generalized across all nine aircraft.

The lack of commonality in the findings may be due to one or more of the following reasons:

a. The data sample of twenty-one observations (fifteen for correlation and regression and six for regression validation) is not large enough for the amount of random variance present in the data. A larger sample size may give more accurate results due to a larger sample's tendency to compensate for the negative effects of random variance.

b. The data may also possess cyclical variance larger than the fifteen month sample analyzed and out of phase between the aircraft. The cycles may be induced by such occurrences as changing aircraft mission requirements or changing management emphasis between categories of production measures induced by changing Air Force leadership.

c. Aircraft maintenance is a complex and dynamic production system in contrast to a relatively stable and controllable manufacturing system. The aircraft maintenance system production flow appears cyclical in contrast to an assembly line manufacturing system with an identifiable material entry and exit point. The maintenance system produces MC rate which is translated into sortie production to meet mission requirements. The resulting sorties become the demand placed back on the system in the form of aircraft servicing and breaks. The result is that higher MC rate produces more aircraft available for sortie production which in-turn increases demand placed on production system. Increased aircraft sorties increases demand on manpower,

equipment and supplies to produce MC rate thereby increasing possible sortie production and the cycle continues. The cyclical nature of the system increases interdependency and collinearity of production measures. The interdependency and collinearity of measures at the very least frustrates the identification of maintenance constraints that enhance or limit production, and at the most, renders the measures at the aggregate level effectively nonexistent.

3. What are the statistical relationships between the maintenance constraints and an organization's production capability? The findings are inconclusive in this area as well. The measures are inconsistent both in occurrence and in nature. Many aircraft failed to identify with some constraints when other aircraft identified significantly. Also, in some cases where commonality of occurrence did exist between two or more aircraft, the nature of the occurrence disagreed. When the occurrence of one aircraft measure identified that production output should increase, the same occurrence of the measure for another aircraft indicated production output should decrease. These inconsistencies occur for a significant percentage of the measures adding doubt to the actual existence of common measures.

4. What maintenance constraints can be used in a predictive model of a maintenance organization's sortie producing capability? The nine aircraft models built for each of the three production output measures of interest are dissimilar. The models global measures of usefulness very widely in strength and are inconsistent with the results of validation. Those models that appeared to possess strong global measures had less observations present in the confidence intervals than did models with weaker global measures. Additionally, validations for

some models showed a higher percentage of observations in the confidence intervals, although the delta between actual and predicted values were larger than for observations outside the confidence intervals in other models. The maintenance constraints included in the regression models lacked commonality. The constraints included in the models were not consistent across all aircraft for the same production output measures.

Based on the research findings and conclusions cited above, maintenance manager's use of productivity measures to evaluate aircraft maintenance performance should be insightful and tempered with the knowledge that aircraft maintenance is a dynamic environment that is difficult to define when postulating performance. Maintenance managers that use performance measures blanketed across all aircraft types and mission environments to judge maintenance performance may find evaluations divergent from reality.

Recommendations

Maintenance managers in SAC need to be careful when evaluating maintenance performance and should not evaluate all aircraft with one, two or even a select group of identical production measurement indicators. Though customizing indicators for each aircraft system is neither practical nor appropriate, insightful qualitative judgement should be used when evaluating the host of indicators. Using one or two indicators for one aircraft type may indicate good performance, and for another aircraft type the same indicators may indicate poor performance.

Suggested Future Research

The results of previous research presented in Chapter II and this thesis indicate that future research in this area at the aggregate level

may not be appropriate. Research at a lower level, such as one particular aircraft serial number of an aircraft system type using a significantly larger data sample over a longer period of time may prove to be profitable. The larger sample may reduce the random and cyclical variance that hindered this research. The methodology used in this thesis appears sound and could help in any future efforts.

Summary

This chapter presented the conclusions, recommendations and suggestion for future research. The findings of the research are inconclusive as to what maintenance constraints are indicators of production capability in aircraft maintenance. Maintenance production is a complex dynamic system that is not easily definable in terms of production inputs and outputs and makes maintenance performance measurement difficult at best.

Appendix A: Aircraft Production Data Files

1. KC-135A/D/E/Q

OBS	AAB	AAR	ABK	ABR	ASU	ASD	CNX	CXR	CAN	CNR	HFN	LTO	LTR
1	9	0.4	132	6.4	6.6	3.9	27	1.6	259	0.13	8014	105	7.4
2	13	0.7	123	6.5	6.4	3.9	34	2.2	216	0.11	7395	99	7.6
3	20	0.8	170	7.0	8.2	4.0	42	2.2	264	0.11	9691	102	5.9
4	11	0.5	160	7.0	7.8	3.8	29	1.6	350	0.15	8739	97	6.1
5	18	0.8	109	4.6	8.1	3.9	34	1.8	285	0.12	9182	105	6.3
6	11	0.5	144	6.1	8.8	3.9	26	1.4	350	0.15	9289	124	7.5
7	9	0.5	118	6.2	6.5	3.9	28	1.9	279	0.15	7331	79	6.0
8	11	0.5	139	6.0	7.9	3.3	41	2.3	319	0.14	7706	124	7.8
9	19	0.9	123	5.5	7.8	4.2	19	1.1	262	0.12	9329	105	6.7
10	16	0.8	117	5.9	6.8	4.1	36	2.3	296	0.15	8178	95	6.8
11	16	0.9	100	5.4	6.6	3.8	36	2.3	295	0.16	7057	95	7.1
12	7	0.4	94	6.0	5.6	3.7	18	1.4	263	0.17	5787	72	7.0
13	13	0.7	141	7.5	6.7	3.9	28	1.9	295	0.16	7301	115	9.2
14	12	0.6	161	8.5	7.0	3.8	40	2.7	262	0.14	7293	109	8.5
15	15	0.7	123	5.5	8.6	3.8	19	1.1	261	0.12	8540	93	6.1
16	20	1.1	122	6.4	7.5	4.0	42	2.9	246	0.13	7586	110	8.5
17	18	0.9	102	4.9	8.4	4.1	37	2.5	255	0.12	8476	85	6.2
18	16	0.9	86	4.7	7.9	3.9	44	3.2	229	0.12	7241	90	7.2
19	11	0.7	82	4.9	7.0	4.1	32	2.5	221	0.13	6873	82	7.2
20	10	0.5	64	3.1	8.6	4.3	35	2.5	265	0.13	8715	73	6.0
21	11	0.7	58	3.6	6.7	4.5	23	2.2	228	0.14	7183	58	6.2

OBS	MHE	MHS	MHF	NMB	NMM	NMS	PMB	PMM	PMS	PSA	PSH
1	349755	169.7	43.6	3.4	4.2	2.8	0.8	6.4	5.2	314.3	233841
2	341479	180.8	46.2	3.5	6.3	4.3	0.4	4.9	5.4	293.4	204215
3	413371	169.6	42.7	4.4	5.3	3.8	0.5	4.2	6.6	296.3	220410
4	351867	153.4	40.3	4.9	4.8	3.5	0.5	3.8	7.6	294.0	211682
5	341807	144.3	37.2	3.7	4.6	2.7	0.7	3.8	5.8	293.1	218049
6	309704	130.5	33.3	4.1	5.2	3.1	0.4	3.9	6.5	270.1	194460
7	315555	166.8	43.0	4.3	4.2	3.4	0.3	3.3	6.1	292.7	217749
8	370530	160.6	48.1	5.3	5.2	3.4	0.4	3.2	6.0	291.0	216475
9	327333	146.6	35.1	4.9	4.7	3.5	0.5	3.9	6.6	286.9	206585
10	349317	176.0	42.7	5.0	5.4	3.5	0.4	4.1	6.5	292.2	217374
11	297988	160.4	42.2	4.1	5.9	4.7	0.9	2.8	9.9	283.2	203918
12	282229	180.1	48.8	5.9	6.7	6.3	0.4	3.3	7.4	281.7	209614
13	309668	163.8	42.4	4.8	5.4	6.3	0.7	3.6	6.9	280.7	208819
14	266575	140.2	36.6	4.4	6.3	5.6	0.6	4.0	7.9	272.8	183294
15	302990	136.5	35.5	5.4	6.1	4.7	0.7	4.2	7.8	257.1	191290
16	317331	167.5	41.8	5.1	7.2	4.1	0.5	3.9	4.5	252.0	181437
17	291394	140.1	34.4	4.5	5.7	3.5	0.8	8.0	5.1	248.7	185015
18	211151	114.7	29.2	4.2	6.3	4.1	0.9	13.6	5.0	233.2	167914
19	241623	143.7	35.2	3.5	5.6	4.4	2.1	13.8	6.1	240.6	178986
20	229705	112.7	26.4	3.5	4.6	3.0	2.2	13.8	7.5	238.1	177118
21	179478	112.9	25.0	3.2	5.4	4.1	2.6	13.0	8.8	238.0	171342

OBS	SAT	SFN	SSD	TNM	TNS	AFR	FMC	MCR	NMC	NFH	PMC
1	1424	2061	1676	7.6	6.2	81.8	77.1	89.6	10.4	108	12.5
2	1296	1889	1556	9.8	7.8	74.8	75.3	85.9	14.1	92	10.7
3	1732	2438	1943	9.7	8.2	67.1	75.2	86.5	13.5	114	11.3
4	1592	2294	1785	9.7	8.4	70.6	74.9	86.8	13.2	113	11.9
5	1677	2368	1859	8.3	6.3	76.1	78.8	89.1	10.9	83	10.3
6	1662	2374	1842	9.3	7.2	79.2	76.8	87.6	12.4	114	10.8
7	1320	1892	1451	8.5	7.7	81.4	78.4	88.1	11.9	96	9.7
8	1592	2307	1786	10.5	8.6	74.8	76.4	86.2	13.9	104	9.7
9	1575	2233	1698	9.6	8.4	72.4	75.8	86.8	13.1	89	11.0
10	1404	1985	1597	10.4	8.5	72.6	75.2	86.1	13.9	85	11.0
11	1344	1858	1569	10.0	8.9	77.0	71.8	85.3	14.7	77	13.5
12	1028	1567	1303	12.6	12.2	68.1	70.0	81.1	18.9	64	11.1
13	1244	1890	1476	10.2	11.1	70.2	72.3	83.5	16.5	99	11.1
14	1280	1902	1489	10.8	10.0	67.7	71.2	83.7	16.3	109	12.5
15	1535	2220	1688	11.5	10.2	75.6	71.3	84.1	16.2	93	12.8
16	1296	1895	1471	12.2	9.2	71.3	74.8	83.6	16.4	87	8.8
17	1367	2080	1486	10.2	8.1	83.3	72.2	86.2	13.8	85	14.0
18	1244	1841	1374	10.5	8.3	76.7	65.9	85.4	14.6	66	19.6
19	1145	1682	1256	9.0	7.8	73.2	64.6	86.6	13.4	60	22.0
20	1219	2038	1400	8.0	6.5	84.4	65.3	88.9	11.1	54	23.5
21	943	1590	1033	8.6	7.3	62.1	62.9	87.3	12.7	36	24.4

2. KC-135R

OBS	AAB	AAR	ABK	ABR	ASU	ASD	CNX	CXR	CAN	CNR	HFN	LTO	LTR
1	3	0.3	49	5.3	7.2	4.0	7	1.0	122	0.13	3723.6	16	2.7
2	7	0.9	48	5.8	6.1	4.1	7	1.1	116	0.14	3411.6	24	4.6
3	4	0.3	63	5.4	8.6	4.1	11	1.3	135	0.12	4777.6	16	2.2
4	3	0.3	67	6.4	7.6	4.1	14	1.8	157	0.15	4271.0	19	2.8
5	15	1.4	53	4.8	7.5	4.3	7	0.8	165	0.15	4680.9	28	3.6
6	10	0.8	90	7.2	8.5	4.0	12	1.3	186	0.15	5004.8	30	3.7
7	3	0.3	67	6.5	6.8	4.1	8	1.0	148	0.14	4229.1	34	5.0
8	11	0.9	72	6.0	8.6	4.0	6	0.7	185	0.15	4738.6	38	4.9
9	10	0.8	70	5.9	7.4	4.2	7	0.9	125	0.11	4929.8	28	4.0
10	8	0.6	91	7.2	7.8	4.2	13	1.4	142	0.11	5388.6	31	3.7
11	9	0.8	59	5.3	7.0	4.1	13	1.6	167	0.15	4514.0	42	5.7
12	6	0.6	57	5.9	5.9	4.2	18	2.6	151	0.16	4080.9	38	7.4
13	4	0.3	63	5.2	7.6	4.2	23	2.5	161	0.13	5061.4	38	5.0
14	5	0.5	85	7.7	7.0	4.3	30	3.6	141	0.13	4721.1	44	6.4
15	6	0.4	75	5.3	8.7	4.4	22	2.2	151	0.11	6240.4	58	6.6
16	7	0.5	80	5.6	8.4	4.2	15	1.5	141	0.10	5944.8	49	5.5
17	8	0.5	57	3.8	8.6	4.2	15	1.5	214	0.14	6385.4	59	6.3
18	8	0.6	43	3.0	8.6	4.1	28	2.8	173	0.12	5975.9	67	7.4
19	15	1.1	46	3.4	6.9	4.0	19	2.2	141	0.10	5548.7	64	8.0
20	9	0.7	31	2.3	7.3	4.8	16	2.1	166	0.12	6593.2	41	6.2
21	12	1.0	21	1.7	6.6	4.2	7	1.1	106	0.09	5076.5	34	5.9

OBS	MHE	MHS	MHF	NMB	NMM	NMS	PMB	PMM	PMS	PSA	PSH
1	136797	148.5	36.7	4.2	3.5	4.5	1.3	4.3	14.8	128.5	95587
2	168823	205.1	49.5	5.6	4.1	5.4	2.2	3.7	15.7	134.0	90060
3	213753	183.6	44.7	5.5	5.1	3.4	1.5	3.7	17.4	134.7	100207
4	184776	177.7	43.3	4.4	3.8	4.2	1.8	2.5	16.0	137.4	98918
5	177826	161.5	38.0	3.9	4.0	3.1	1.0	2.6	14.2	147.4	106103
6	150798	120.9	30.1	3.2	3.2	3.5	1.0	3.2	17.3	146.5	105497
7	149952	145.7	35.5	3.3	3.0	3.3	1.1	3.5	16.1	151.3	112535
8	167856	140.3	35.4	3.6	3.6	2.9	1.2	3.5	14.0	139.7	103951
9	141175	119.6	28.6	5.0	5.2	2.9	0.9	5.4	17.9	159.6	114876
10	160140	125.9	29.7	3.8	5.8	4.1	1.3	6.3	12.2	163.9	121959
11	162244	145.9	35.9	5.4	5.4	3.0	1.8	6.9	11.9	158.8	114368
12	152927	158.6	37.5	4.6	6.5	5.2	2.4	12.1	11.4	162.0	120558
13	160430	132.3	31.7	4.3	5.8	5.9	3.0	8.1	14.6	160.1	119149
14	163499	147.6	34.6	5.0	6.5	7.2	2.3	7.2	10.2	157.3	105725
15	192674	135.8	30.9	4.4	6.1	5.1	2.9	9.0	10.8	163.2	121420
16	148597	104.1	25.0	4.2	3.8	4.3	1.7	8.1	8.7	169.9	122301
17	179388	118.1	28.1	4.7	5.4	3.5	1.1	4.8	9.5	176.5	131283
18	194682	134.9	32.6	3.1	4.6	3.1	2.1	3.8	11.9	167.9	120859
19	153994	112.3	27.8	3.3	4.6	3.5	1.6	3.7	11.1	199.9	148757
20	117190	86.0	17.8	2.1	2.8	2.2	1.5	5.2	12.4	187.1	139231
21	109105	89.4	21.5	1.5	3.2	3.3	1.3	4.5	15.8	185.1	133289

OBS	SAT	SFN	SSD	TNM	TNS	AFR	FMC	MCR	NMC	NFH	PMC
1	592	921	702	7.7	8.7	69.4	67.4	87.8	12.2	34	20.4
2	527	823	661	9.7	11.0	77.1	63.3	84.9	15.1	37	21.6
3	725	1164	841	10.6	8.9	50.8	63.3	86.0	14.0	32	22.6
4	688	1040	761	8.2	8.7	47.8	67.2	87.6	12.4	32	20.3
5	773	1101	870	8.0	7.0	58.5	71.2	88.9	11.1	31	17.8
6	821	1247	894	6.4	6.7	48.9	68.6	90.1	9.9	44	21.5
7	685	1029	764	6.3	6.6	68.7	69.7	90.4	9.6	46	20.7
8	778	1196	886	7.2	6.5	72.2	71.2	89.9	10.1	52	18.7
9	701	1180	769	10.1	7.9	81.4	62.7	86.9	13.1	57	24.2
10	838	1272	947	9.6	7.9	69.2	66.5	86.3	13.7	63	19.8
11	737	1112	834	10.8	8.4	74.6	65.5	86.2	13.8	44	20.7
12	517	964	705	11.1	9.8	57.9	57.8	83.7	16.3	33	25.9
13	754	1213	907	10.0	10.2	71.4	58.3	84.1	15.9	45	25.7
14	691	1108	823	11.5	12.2	72.9	61.5	81.3	18.7	62	19.8
15	878	1419	1021	10.5	9.4	65.3	61.8	84.5	15.5	49	22.7
16	891	1427	991	8.1	8.6	72.5	69.1	87.6	12.4	58	18.6
17	938	1519	1007	10.1	2.2	71.9	70.9	86.4	13.6	41	15.5
18	901	1443	983	7.6	6.1	69.8	71.6	89.3	10.7	30	17.7
19	799	1371	863	7.9	6.9	71.7	72.1	88.5	11.5	33	16.4
20	666	1362	761	5.0	4.4	61.3	73.7	92.8	7.2	19	19.0
21	580	1221	618	4.7	4.8	66.7	70.3	92.0	8.0	14	21.7

3. RC-135V/N

OBS	AAB	AAR	ABK	ABR	ASU	ASD	CNX	CXR	CAN	CNR	HFN	LTO
1	3	3.5	15	17.4	8.0	7.3	2	2.8	13	0.15	628.3	7
2	2	2.3	22	25.6	8.1	7.2	3	4.3	7	0.08	623.4	7
3	2	1.7	22	18.3	11.5	7.8	8	7.8	4	0.03	931.3	7
4	1	1.0	8	7.8	9.7	8.6	1	1.1	13	0.13	889.7	12
5	5	4.1	29	23.8	11.1	7.5	5	4.6	3	0.02	912.3	5
6	3	2.5	33	28.0	10.7	8.1	2	2.1	23	0.19	955.5	8
7	3	3.1	22	22.9	9.5	9.1	4	4.3	8	0.08	869.7	5
8	2	2.2	20	22.5	8.7	8.2	6	7.3	10	0.11	733.2	9
9	0	0.0	22	21.8	9.2	8.4	3	3.2	13	0.13	852.7	7
10	1	0.9	25	23.4	10.1	8.4	5	5.0	10	0.09	903.7	9
11	1	1.2	18	21.7	6.9	8.7	6	7.4	13	0.16	724.0	3
12	0	0.0	15	17.6	8.7	9.3	10	11.4	14	0.16	792.1	4
13	2	2.4	28	33.7	8.5	8.5	10	12.7	17	0.20	701.8	12
14	0	0.0	24	27.9	7.8	8.8	2	2.4	11	0.13	756.5	4
15	0	0.0	16	15.2	10.5	7.8	3	3.5	16	0.15	815.1	6
16	0	0.0	17	17.5	11.6	8.2	5	5.4	8	0.08	792.5	7
17	1	1.1	16	17.4	9.5	7.7	0	0.0	3	0.03	712.8	8
18	4	4.0	21	20.8	11.5	7.6	13	14.9	5	0.05	768.5	4
19	6	5.5	26	23.9	10.9	8.0	3	2.8	12	0.11	876.2	10
20	1	0.9	9	7.8	11.3	9.1	2	1.8	6	0.05	1053.8	5
21	0	0.0	12	14.6	7.6	9.7	3	3.8	6	0.07	792.8	3

OBS	LTR	MHE	MHS	MHF	NMB	NMM	NMS	PMB	PMM	PMS	PSA
1	10.6	31673	368.3	50.4	12.2	15.3	6.0	1.8	10.9	9.5	10.8
2	11.3	33233	386.4	53.3	13.9	15.8	12.3	2.4	8.2	8.3	10.6
3	7.8	32798	273.3	35.2	9.8	16.3	11.9	7.5	8.8	9.5	10.4
4	13.3	31012	301.1	34.9	8.6	12.2	4.2	5.7	5.2	20.6	10.6
5	5.0	32302	264.8	35.4	9.5	16.8	5.0	5.0	5.7	18.8	10.9
6	8.9	30708	260.2	32.1	12.7	15.1	10.1	1.1	9.8	16.7	11.0
7	5.7	24102	251.1	27.7	7.8	14.7	4.8	1.7	4.0	4.6	10.1
8	12.0	28776	323.3	39.2	12.0	11.1	2.2	2.6	4.3	15.4	10.2
9	8.1	27925	276.5	32.7	13.5	13.9	2.1	1.4	6.3	11.4	11.0
10	10.1	31645	295.7	35.0	6.3	13.6	1.3	2.0	11.0	6.5	10.6
11	4.2	28365	341.7	39.2	13.7	10.2	1.8	1.9	3.8	9.7	12.1
12	5.2	26375	310.3	33.3	19.8	13.3	5.7	2.0	6.2	11.9	9.8
13	17.6	27316	329.1	38.9	23.2	9.7	15.6	0.8	4.3	5.5	9.8
14	5.1	26083	303.3	34.5	15.8	6.4	11.0	0.6	3.3	5.8	11.0
15	7.4	27082	257.9	33.2	13.1	13.5	11.6	2.0	8.0	13.7	10.0
16	8.1	25304	260.9	31.9	15.8	15.8	8.7	1.1	12.7	4.5	8.4
17	10.4	27843	302.6	39.1	9.6	16.7	10.2	0.7	4.2	20.2	9.7
18	5.7	26195	259.4	34.1	9.1	18.4	13.9	0.2	5.4	9.1	8.8
19	9.4	24315	223.1	27.8	16.4	11.1	6.0	2.2	11.0	20.4	10.0
20	4.6	17311	149.2	16.4	5.4	8.8	5.3	0.3	5.4	14.5	10.3
21	3.9	15768	192.3	19.9	16.7	10.4	6.2	0.5	7.2	4.3	10.9

OBS	PSH	SAT	SFN	SSD	TNM	TNS	AFR	FMC	MCR	NMC	NFH	PMC
1	8004	66	86	71	27.5	18.2	40.0	44.4	66.6	33.4	6	22.2
2	7391	62	86	69	29.7	26.2	50.0	39.0	58.0	42.0	11	18.9
3	7746	90	120	102	26.1	21.7	50.0	36.3	62.0	38.0	11	25.8
4	7616	90	103	91	20.8	12.8	12.5	43.6	75.1	24.9	1	31.4
5	8144	101	122	108	26.3	14.5	34.5	39.3	68.7	31.3	10	29.4
6	7904	90	118	95	27.8	22.8	30.3	34.6	62.1	37.9	10	27.5
7	7547	87	96	94	22.6	12.6	59.1	62.5	72.7	27.3	13	10.2
8	7600	75	89	82	23.2	14.2	50.0	52.4	74.7	25.3	10	22.3
9	7913	86	101	93	27.4	15.6	40.9	51.4	70.5	29.5	9	19.1
10	7910	89	107	100	19.9	7.6	52.0	59.2	78.7	21.3	13	19.5
11	8676	72	83	81	23.9	15.5	44.4	58.9	74.3	25.7	8	15.4
12	7287	77	85	88	33.1	25.4	46.7	41.1	61.2	38.8	7	20.1
13	7294	68	83	79	32.9	38.8	53.6	40.9	51.5	48.5	15	10.6
14	7378	79	86	85	22.2	26.8	33.3	57.2	66.8	33.2	8	9.6
15	7439	81	105	86	26.6	24.7	43.8	38.2	61.8	38.2	7	23.6
16	6037	86	97	92	31.6	24.5	23.5	41.4	59.7	40.3	4	18.3
17	7199	77	92	78	26.3	19.8	43.8	38.4	63.5	36.5	7	25.1
18	6312	70	101	87	27.5	23.0	52.4	43.9	58.6	41.4	11	14.7
19	7440	106	109	109	27.5	22.4	30.8	32.9	66.5	33.5	8	33.7
20	7632	109	116	114	14.2	10.7	44.4	60.3	80.5	19.5	4	20.2
21	7817	76	82	79	27.1	22.8	16.7	54.8	66.7	33.3	2	12.0

4. EC-135A/C/G/L/N/Y

OBS	AAB	AAR	ABK	ABR	ASU	ASD	CNX	CXR	CAN	CNR	HFN	LTO	LTR
1	0	0.0	75	33.9	9.2	6.1	8	4.8	25	0.11	1352.3	11	7.6
2	2	0.9	62	29.4	9.3	5.8	17	9.7	29	0.14	1216.8	16	11.3
3	4	1.4	97	34.6	11.7	5.7	7	3.1	18	0.06	1584.8	23	11.4
4	5	1.9	73	27.9	10.5	5.5	7	3.7	43	0.16	1429.1	20	11.7
5	4	1.6	67	26.9	9.6	5.9	5	2.6	15	0.06	1457.8	10	5.6
6	2	0.8	79	30.9	9.3	5.6	9	4.7	47	0.18	1442.7	12	6.9
7	8	3.6	98	44.3	8.2	5.9	9	4.9	31	0.14	1314.3	16	9.4
8	2	0.8	84	32.7	15.7	5.6	9	4.5	49	0.19	1449.5	11	6.0
9	2	1.0	85	41.3	5.9	6.3	8	4.7	37	0.18	1300.4	11	6.9
10	1	0.4	80	34.6	9.1	6.0	10	4.9	45	0.19	1392.8	16	8.7
11	0	0.0	75	34.7	8.6	5.8	11	6.4	43	0.20	1249.7	12	8.0
12	0	0.0	75	36.9	8.2	6.0	16	8.8	27	0.13	1224.1	15	10.3
13	3	1.3	76	32.1	9.7	5.9	6	3.2	27	0.11	1398.9	13	7.4
14	0	0.0	101	52.6	7.5	6.1	9	5.4	35	0.18	1172.7	14	9.4
15	2	0.9	96	42.9	9.0	6.1	9	4.7	35	0.16	1372.7	18	10.8
16	0	0.0	140	59.1	9.9	5.9	0	0.0	24	0.10	1397.7	14	7.4
17	1	0.4	102	44.0	9.9	6.0	9	4.5	35	0.15	1401.8	16	8.6
18	0	0.0	71	30.5	10.0	5.7	2	1.1	15	0.06	1326.8	11	6.5
19	5	2.5	76	37.8	7.9	5.5	4	2.5	22	0.11	1112.5	12	8.0
20	3	1.6	58	31.9	7.4	4.3	9	6.6	32	0.18	789.5	16	12.7
21	0	0.0	41	26.5	6.7	4.4	3	2.7	12	0.08	685.7	11	10.3

OBS	MHE	MHS	MHF	NMB	NMM	NMS	PMB	PMM	PMS	PSA	PSH
1	51863	234.7	38.4	7.7	7.8	8.8	3.9	3.6	7.5	24.0	17884
2	52507	248.8	43.2	9.2	9.8	5.5	1.5	6.9	7.2	22.8	15865
3	56848	203.0	35.9	8.6	7.9	5.7	1.9	4.4	16.1	24.0	17855
4	51814	197.8	36.3	7.8	7.2	8.0	1.3	6.2	12.0	24.9	17914
5	59468	238.8	40.8	7.9	6.0	5.4	0.9	3.4	11.8	25.9	19271
6	51335	200.5	35.6	11.3	10.5	6.6	0.9	12.7	7.9	27.6	19872
7	48852	221.0	37.2	11.9	7.9	11.7	1.5	7.1	3.3	27.0	20088
8	49162	191.3	33.9	7.7	7.7	9.7	1.9	4.6	14.3	16.3	12155
9	42840	208.0	32.9	6.9	10.7	11.5	0.9	2.7	7.6	35.1	25250
10	46774	202.5	33.6	9.0	11.5	3.6	3.8	6.4	8.9	25.3	18811
11	47958	222.0	38.4	10.3	15.4	5.4	0.8	6.6	5.5	25.0	18000
12	48227	237.6	39.4	12.2	17.4	8.4	1.1	5.4	3.9	24.7	18372
13	49173	207.5	35.2	10.8	11.7	8.0	2.3	4.8	6.0	24.3	18108
14	42723	222.5	36.4	15.9	11.6	13.3	1.1	1.9	4.6	25.8	17316
15	41411	184.9	30.2	15.5	7.0	5.7	1.2	4.9	4.1	25.0	18600
16	45238	190.9	32.4	11.0	20.0	9.8	0.7	2.3	8.6	24.0	17249
17	48887	210.7	34.9	9.2	13.8	6.8	1.1	2.1	7.6	23.4	17445
18	49600	212.9	37.4	8.5	12.2	7.7	2.0	3.9	7.4	23.2	16696
19	46554	231.6	41.8	6.1	17.4	10.2	1.3	4.2	9.9	25.5	18972
20	38184	209.8	48.4	9.9	7.3	8.8	3.3	2.2	9.4	24.5	18205
21	25392	163.8	37.0	9.2	6.3	8.4	1.0	7.5	6.8	23.2	16713

OBS	SAT	SFN	SSD	TNM	TNS	AFR	FMC	MCR	NMC	NFH	PMC
1	145	221	167	15.5	16.5	62.7	60.7	75.7	24.3	47	15.0
2	141	211	175	19.0	14.7	66.1	59.9	75.5	24.5	41	15.6
3	201	280	223	16.4	14.2	58.8	55.5	77.9	22.1	57	22.4
4	171	262	189	15.0	15.9	65.8	57.5	76.9	23.1	48	19.4
5	180	249	195	13.9	13.3	73.1	64.6	80.7	19.3	49	16.1
6	175	256	191	21.8	17.9	58.2	50.1	71.7	28.4	46	21.6
7	170	221	185	19.8	23.6	62.2	56.6	68.5	31.4	61	11.9
8	184	257	202	15.4	17.4	54.8	54.1	74.9	25.1	46	20.9
9	160	206	172	17.6	18.3	61.2	57.7	69.0	29.0	52	11.2
10	183	231	204	20.5	12.6	75.0	56.8	75.9	24.1	60	19.1
11	150	216	172	25.7	15.7	66.7	56.0	68.9	31.5	50	12.9
12	145	203	182	29.7	20.6	82.7	51.5	61.9	38.1	62	10.4
13	176	237	189	22.5	18.8	69.7	56.8	69.6	30.4	53	13.1
14	149	192	166	27.5	29.2	68.3	51.7	59.2	40.8	69	7.5
15	167	224	191	22.6	21.2	62.5	53.8	63.9	36.4	60	10.1
16	188	237	195	31.0	20.7	68.6	47.6	59.3	40.7	96	11.7
17	186	232	201	23.0	16.0	69.6	59.3	70.2	29.8	71	10.9
18	169	233	178	20.7	16.2	76.1	58.3	71.6	28.4	54	13.3
19	150	201	158	23.8	16.3	71.1	50.9	66.3	33.7	54	15.4
20	126	182	137	17.1	17.0	63.8	59.2	74.1	25.9	37	14.9
21	107	155	110	15.5	17.6	63.4	60.7	76.0	24.0	26	15.3

5. E-4B

OBS	AAB	AAR	ABK	ABR	ASU	ASD	CNX	CXR	CAN	CNR	HFN	LTO
1	2	5.9	6	17.6	11.3	3.8	0	0.0	1	0.03	128.1	4
2	2	6.9	5	17.2	10.0	4.9	1	3.6	1	0.03	143.4	8
3	2	5.4	6	16.2	12.3	4.2	4	11.8	0	0.00	156.1	2
4	0	0.0	8	24.2	8.3	5.1	1	3.1	2	0.06	169.4	3
5	3	8.3	10	27.8	12.0	3.9	6	15.8	0	0.00	142.1	3
6	0	0.0	4	13.8	9.7	3.7	2	6.3	1	0.03	108.3	1
7	1	3.7	8	29.6	11.6	3.7	2	9.1	0	0.00	101.2	1
8	1	1.8	17	30.9	18.3	3.3	5	11.1	3	0.05	179.3	3
9	0	0.0	8	19.0	12.1	3.6	0	0.0	2	0.05	150.7	4
10	0	0.0	4	10.0	13.0	4.0	1	2.7	1	0.03	161.8	2
11	0	0.0	4	12.1	11.0	3.6	1	3.8	3	0.09	119.9	6
12	1	3.4	4	13.8	9.7	4.8	0	0.0	1	0.03	139.2	2
13	0	0.0	10	25.6	13.0	3.8	2	5.9	3	0.08	150.1	1
14	0	0.0	4	8.3	16.0	3.5	3	6.8	3	0.06	168.9	2
15	0	0.0	2	3.9	17.0	3.4	1	2.3	0	0.00	175.5	5
16	0	0.0	4	9.1	11.8	4.3	1	2.4	9	0.20	190.4	1
17	0	0.0	6	12.5	13.1	3.6	1	2.4	4	0.08	173.9	1
18	1	2.4	2	4.8	14.0	2.6	3	7.7	3	0.07	109.8	0
19	1	2.6	1	2.6	13.0	3.3	0	0.0	0	0.00	129.4	3
20	0	0.0	14	32.6	14.3	3.2	4	9.3	4	0.09	137.1	2
21	0	0.0	18	36.0	14.1	3.5	3	6.5	7	0.14	175.9	0

OBS	LTR	MHE	MHS	MHF	NMB	NMM	NMS	PMB	PMM	PMS	PSA
1	13.3	4670	137.4	36.5	4.2	14.1	0.6	4.3	0.5	7.5	3.0
2	29.6	9580	330.3	66.8	10.5	18.1	0.0	0.0	4.1	0.0	2.9
3	6.7	8104	219.0	51.9	0.0	21.6	0.0	0.0	2.7	0.0	3.0
4	9.7	8253	250.1	48.7	0.8	7.0	2.8	1.1	8.0	4.7	4.0
5	10.0	10527	292.4	74.1	9.8	17.7	4.2	1.3	4.6	0.3	3.0
6	4.0	10892	375.6	100.6	11.7	32.1	0.1	0.0	1.0	0.0	3.0
7	5.0	5869	217.4	58.0	12.5	14.8	0.0	0.0	0.6	0.0	2.3
8	7.5	15812	287.5	88.2	2.0	22.3	1.3	0.3	6.2	0.0	3.0
9	11.1	10929	260.2	72.5	4.5	6.7	5.9	1.0	10.0	2.2	3.5
10	5.6	18734	468.4	115.8	19.3	5.5	3.0	0.0	36.3	0.0	3.1
11	24.0	10777	326.6	89.9	25.0	5.1	4.1	2.3	3.1	12.5	3.0
12	8.7	14262	491.8	102.5	1.2	7.1	0.0	13.3	3.6	47.0	3.0
13	3.2	11499	294.8	76.6	2.8	27.1	1.8	3.3	2.2	37.1	3.0
14	5.0	7849	163.5	46.5	4.5	18.0	0.0	9.6	5.9	26.2	3.0
15	11.6	9166	179.7	52.2	1.8	26.4	0.0	5.6	29.4	10.0	3.0
16	2.6	10561	240.0	55.5	10.0	14.8	0.0	0.1	17.1	12.7	3.7
17	2.5	9794	204.0	56.3	0.6	23.2	0.2	9.0	14.5	10.0	3.7
18	0.0	7606	181.1	69.3	0.0	27.5	0.0	1.5	4.4	24.8	3.0
19	8.8	6216	159.4	48.0	0.5	10.3	9.7	4.3	6.3	4.3	3.0
20	5.1	7896	183.6	57.6	11.4	18.2	7.8	1.3	11.5	2.7	3.0
21	0.0	6419	128.4	36.5	10.3	14.1	0.0	6.0	7.6	10.2	3.5

OBS	PSH	SAT	SFN	SSD	TNM	TNS	AFR	FMC	MCR	NMC	NFH	PMC
1	2232	30	34	30	18.3	4.8	83.3	68.7	81.1	18.9	5	12.4
2	2016	27	29	28	28.6	10.5	80.0	67.3	71.4	28.6	4	4.1
3	2232	30	37	34	21.6	0.0	83.3	75.6	78.3	21.6	5	2.7
4	2864	31	33	32	7.8	3.6	62.5	75.5	89.4	10.6	5	13.8
5	2232	30	36	38	17.2	13.9	40.0	62.1	68.4	31.6	4	6.2
6	2160	25	29	32	43.8	11.8	50.0	55.1	56.1	43.8	2	1.0
7	1727	20	27	22	27.3	12.5	87.5	72.1	72.7	27.3	7	0.6
8	2232	40	55	45	24.3	3.2	64.7	68.0	74.5	25.5	11	6.5
9	2506	36	42	37	11.4	10.4	75.0	69.5	82.8	17.2	6	13.2
10	2290	36	40	37	24.8	22.3	75.0	35.9	72.2	27.8	3	36.3
11	2160	25	33	26	30.1	29.2	50.0	47.9	65.7	34.3	2	17.8
12	2232	23	29	23	8.3	1.2	100.0	27.8	91.7	8.3	4	63.9
13	2232	31	39	34	29.9	4.7	40.0	25.7	68.3	31.7	4	42.6
14	2016	40	48	44	22.5	4.5	25.0	35.8	77.5	22.5	1	41.7
15	2232	43	51	44	28.2	1.8	0.0	26.7	71.8	28.2	0	45.1
16	2676	39	44	42	24.8	10.0	100.0	45.3	75.1	24.9	4	29.9
17	2723	40	48	41	23.8	0.8	0.0	42.5	76.0	24.0	0	33.5
18	2160	34	42	39	27.5	0.0	50.0	41.7	72.5	27.5	1	30.7
19	2232	34	39	36	10.8	10.1	100.0	64.6	79.5	20.5	1	14.9
20	2232	39	43	43	29.7	19.2	64.3	47.1	62.5	37.5	9	15.5
21	2549	41	50	46	24.4	10.3	50.0	51.8	75.6	24.4	9	23.8

6. <u>B-1B</u>

OBS	AAB	AAR	ABK	ABR	ASU	ASD	CNX	CXR	CAN	CNR	HFN	LTO	LTR
1	20	4.6	167	38.6	5.7	4.5	64	16.3	488	16.3	1930.9	57	21.3
2	22	5.6	160	40.5	5.1	4.7	58	15.2	476	15.2	1867.0	46	20.1
3	12	2.7	165	37.5	6.0	5.0	41	9.6	527	9.6	2206.6	50	19.9
4	29	6.3	154	33.5	6.1	4.9	38	8.9	378	8.9	2255.5	44	15.9
5	46	8.6	214	39.9	7.2	4.7	51	10.9	519	10.9	2540.8	73	20.9
6	39	7.4	209	39.5	6.9	4.5	49	12.2	395	12.2	2362.3	68	20.4
7	34	7.5	159	34.9	6.0	4.4	30	8.7	535	8.7	2018.4	62	21.4
8	31	5.9	165	31.4	10.9	4.2	31	7.8	522	7.8	2200.9	57	17.1
9	22	4.9	119	26.7	4.6	4.1	26	8.3	350	8.3	1844.5	37	14.3
10	19	3.5	159	29.1	7.5	4.4	25	6.3	580	6.3	2381.8	54	15.7
11	24	5.2	123	26.6	6.4	4.4	60	16.3	397	16.3	2026.3	55	19.8
12	13	3.6	127	34.8	5.0	4.4	45	13.3	473	13.3	1602.3	44	22.1
13	22	4.4	185	36.8	7.0	4.8	48	12.6	363	12.6	2410.9	59	21.5
14	18	4.1	137	31.4	6.1	4.8	42	11.7	418	11.7	2080.6	49	19.2
15	28	5.1	181	32.8	7.7	4.5	43	10.7	470	10.7	2469.5	51	16.9
16	30	5.8	155	29.8	7.2	4.5	31	8.8	320	8.8	2331.8	44	15.6
17	29	5.6	173	33.2	7.3	4.4	32	8.3	369	8.3	2296.9	45	14.0
18	37	7.1	144	27.8	6.8	4.2	38	10.8	377	10.8	2175.1	65	21.3
19	25	5.0	156	31.0	7.0	4.1	21	6.5	223	6.5	2090.5	50	17.1
20	29	5.8	165	32.8	6.9	4.4	33	9.9	385	9.9	2208.3	59	20.0
21	15	4.0	95	25.6	4.9	4.5	17	6.8	426	6.8	1653.6	46	20.0

OBS	MHE	MHS	MHF	NMB	NMM	NMS	PMB	PMM	PMS	PSA	PSH
1	118266	273.1	61.2	16.8	19.9	16.6	12.3	4.3	30.1	76.5	56937
2	120345	304.7	64.5	17.8	19.9	16.6	14.6	1.8	29.4	73.3	49277
3	142641	324.2	64.6	14.1	15.5	20.4	10.2	6.6	33.2	73.1	54361
4	139590	303.5	61.9	15.8	13.5	22.3	6.9	7.5	34.0	74.9	53935
5	131286	244.9	51.7	13.7	19.1	19.7	6.5	4.0	37.1	74.7	55544
6	117504	222.1	49.7	13.6	13.4	23.3	8.2	5.9	35.5	76.1	54813
7	134599	295.8	65.7	15.3	11.7	18.6	11.6	8.2	34.6	75.3	56045
8	139845	265.9	63.5	15.8	15.4	18.6	18.8	6.1	24.2	48.3	35972
9	117344	263.1	63.6	13.7	13.7	21.0	12.8	2.8	36.0	97.7	70324
10	146929	269.1	61.7	12.6	14.6	23.4	15.5	6.9	27.0	72.7	54086
11	122053	264.2	60.2	13.8	11.1	23.7	16.4	6.3	28.7	71.7	51619
12	118984	326.0	74.3	14.1	15.2	23.5	12.7	7.1	27.4	73.7	54815
13	131916	262.3	54.7	11.8	11.5	25.0	11.6	9.2	30.9	72.1	53662
14	121608	278.3	58.4	14.2	13.1	19.0	14.5	8.6	30.6	71.8	48263
15	136792	248.3	55.4	15.3	13.4	17.4	16.0	7.5	30.3	71.4	53099
16	122392	235.4	52.5	11.8	12.3	16.8	17.1	8.3	33.8	72.0	51847
17	126619	243.0	55.1	8.0	11.5	18.3	21.0	9.1	32.1	71.6	53265
18	112866	217.9	51.9	11.5	14.1	18.1	15.6	7.8	32.9	76.0	54710
19	91634	181.8	43.8	9.8	12.3	18.9	19.6	10.4	29.0	71.5	53208
20	107997	214.7	48.9	9.7	13.2	20.4	18.5	13.3	24.9	72.5	53933
21	104257	281.0	63.0	9.2	11.4	21.6	16.8	10.3	30.7	75.2	54117

OBS	SAT	SFN	SSD	TNM	TNS	AFR	FMC	MCR	NMC	NFH	PMC
1	267	433	392	36.7	33.4	49.7	0.0	46.7	53.3	83	46.7
2	229	395	381	37.6	34.4	55.0	0.0	45.8	54.2	88	45.8
3	251	440	425	29.6	34.5	52.7	0.0	50.0	50.0	87	50.0
4	276	460	427	29.3	38.2	61.7	0.0	48.4	51.6	95	48.4
5	349	536	468	32.8	33.4	41.1	0.0	47.5	52.5	88	47.5
6	334	529	401	27.0	35.9	43.1	0.3	49.7	50.3	90	49.6
7	290	455	343	27.0	33.9	51.6	0.0	54.4	45.6	82	54.4
8	333	526	396	31.3	34.4	54.5	[illegible]	50.2	49.8	90	49.1
9	259	446	314	27.4	34.6	61.3	0.0	51.6	48.4	73	51.6
10	343	546	396	27.3	36.1	60.4	0.0	49.3	50.7	96	49.3
11	278	462	368	24.9	37.5	58.5	[illegible]	51.4	48.6	72	51.4
12	199	365	339	29.3	37.6	42.5	0.0	47.2	52.8	54	47.2
13	275	503	381	23.3	36.7	66.5	0.0	51.7	48.3	123	51.7
14	255	437	358	27.3	33.1	58.4	0.0	53.7	46.3	80	53.7
15	302	551	402	28.7	32.8	64.1	0.0	53.9	46.1	116	53.9
16	282	520	353	24.1	28.6	61.9	0.0	59.2	40.9	96	59.2
17	322	521	386	19.5	26.3	63.0	0.0	62.2	37.8	109	62.2
18	305	518	352	25.6	29.6	59.7	0.0	56.3	43.7	86	56.3
19	292	504	325	22.1	28.7	55.1	0.0	59.0	41.0	86	59.0
20	295	503	333	22.9	30.1	60.0	0.0	56.7	43.3	99	56.7
21	230	371	250	20.6	30.8	45.3	0.0	57.9	42.1	43	57.9

7. B-52H

OBS	AAB	AAR	ABK	ABR	ASU	ASD	CNX	CXR	CAN	CNR	HFN	LTO	LTR
1	3	0.7	206	47.2	5.3	6.1	13	3.6	201	0.46	2643.7	37	11.9
2	3	0.8	221	55.5	5.0	6.2	15	4.4	219	0.55	2463.5	45	16.4
3	5	0.9	243	43.7	6.9	6.8	17	3.4	124	0.22	3782.7	37	8.4
4	4	0.9	209	46.0	5.5	6.4	20	5.6	231	0.51	2896.3	29	9.2
5	6	1.3	232	49.9	5.7	6.5	19	5.2	223	0.48	3003.6	44	13.7
6	2	0.4	213	41.9	6.3	6.0	16	3.9	157	0.31	3047.1	41	11.3
7	2	0.5	205	47.3	5.3	6.3	2	0.6	184	0.42	2749.1	41	12.9
8	8	1.7	218	46.3	5.8	6.4	12	3.0	211	0.45	3027.8	26	7.1
9	0	0.0	165	37.2	5.4	6.1	8	2.1	255	0.58	2714.6	22	6.1
10	6	1.3	200	42.3	5.8	6.1	17	4.3	242	0.51	2896.4	44	12.0
11	8	1.8	158	35.1	5.4	6.3	12	3.1	177	0.39	2836.3	53	15.3
12	3	0.8	126	32.7	4.7	5.6	25	7.4	198	0.51	2147.1	50	18.1
13	6	1.3	173	38.3	5.5	6.3	10	2.7	253	0.56	2865.6	39	11.7
14	4	1.0	128	31.5	5.0	6.4	16	4.6	222	0.55	2586.4	35	11.4
15	8	1.6	161	31.9	6.2	6.0	24	5.4	223	0.44	3049.4	41	10.1
16	6	1.2	141	29.3	6.0	5.9	11	2.9	178	0.37	2847.0	43	12.5
17	6	1.3	153	34.0	5.7	6.3	14	3.7	178	0.40	2852.2	32	9.4
18	5	1.1	167	36.3	6.0	6.0	15	4.3	171	0.37	2773.8	35	11.0
19	2	0.4	163	34.0	6.0	6.6	12	3.4	166	0.35	3144.0	37	11.1
20	3	0.6	182	35.2	6.3	6.2	19	4.6	227	0.44	3198.2	41	10.6
21	1	0.3	127	37.6	4.1	6.4	7	2.6	237	0.70	2174.5	33	13.2

OBS	MHE	MHS	MHF	NMB	NMM	NMS	PMB	PMM	PMS	PSA	PSH
1	129268	296.5	48.9	8.4	9.1	3.6	0.2	5.1	3.7	81.8	60827
2	138319	347.5	56.1	9.4	11.1	3.8	0.4	7.5	4.1	79.4	55282
3	153242	275.6	40.5	9.9	9.4	4.5	1.0	4.9	6.3	81.0	60281
4	139782	307.9	48.3	10.1	7.6	8.4	0.6	2.9	6.2	82.0	59035
5	157972	339.7	52.6	8.1	9.7	4.8	0.9	2.2	8.5	82.1	61095
6	165596	326.0	54.3	8.2	8.1	2.9	1.0	5.5	7.0	81.1	58362
7	116320	268.6	42.3	8.9	9.0	6.1	1.2	4.3	10.4	81.5	60651
8	138618	294.3	45.8	7.5	7.9	6.1	0.5	7.1	10.3	81.8	60890
9	131319	296.4	48.4	8.9	7.3	6.6	0.9	4.8	8.9	82.2	59194
10	157346	332.7	54.3	9.5	9.6	6.6	0.9	4.5	5.4	82.0	61012
11	141864	315.3	50.0	8.3	9.1	5.8	0.9	6.3	8.7	82.7	59533
12	131103	340.5	61.1	8.5	9.4	3.9	1.7	8.9	12.2	82.4	61341
13	140604	311.1	49.1	8.0	10.9	3.6	2.0	7.1	10.2	82.6	61450
14	136068	335.1	52.6	7.3	8.6	4.9	1.3	7.3	11.6	80.7	54201
15	166691	330.1	54.7	7.6	10.2	3.5	3.4	9.3	10.2	81.8	60892
16	166383	345.2	58.4	7.2	9.4	4.2	1.0	10.1	4.3	80.2	57742
17	160629	357.0	56.3	5.7	8.7	3.6	0.8	8.2	7.5	79.4	59043
18	143260	311.4	51.6	6.0	10.6	2.5	1.7	6.9	6.1	76.9	55352
19	143220	298.4	45.6	7.4	10.1	3.9	1.8	6.1	5.0	80.1	59560
20	142783	276.2	44.6	6.0	11.5	5.9	1.4	8.1	10.5	82.0	60986
21	95571	282.8	44.0	6.6	7.7	3.9	1.6	7.5	18.2	82.1	59101

OBS	SAT	SFN	SSD	TNM	TNS	AFR	FMC	MCR	NMC	NFH	PMC
1	312	436	362	17.5	12.0	73.8	69.9	78.9	21.1	152	9.0
2	275	398	339	20.5	13.2	70.1	63.7	75.7	24.3	155	11.9
3	442	556	494	19.3	14.4	66.3	64.0	76.3	23.7	161	12.2
4	315	454	357	17.7	18.4	72.2	64.3	74.0	26.0	151	9.6
5	322	465	367	17.8	12.9	68.5	65.9	77.4	22.6	159	11.9
6	364	508	406	16.3	11.1	73.7	71.1	80.8	19.2	157	13.5
7	318	433	339	15.0	17.8	64.9	60.1	76.0	24.0	133	15.9
8	367	471	397	15.4	13.7	73.9	60.5	78.4	21.6	161	17.9
9	363	443	382	16.3	15.5	67.3	62.6	77.2	22.8	111	14.5
10	368	473	395	19.2	16.1	60.0	63.4	74.2	25.8	120	10.8
11	346	450	390	17.3	14.0	69.0	60.9	76.9	23.1	109	16.0
12	277	385	339	17.9	12.4	70.6	55.4	78.2	21.8	89	22.8
13	333	452	364	18.8	11.5	76.9	58.3	77.6	22.4	133	19.3
14	306	406	347	15.9	12.2	74.2	59.0	79.2	20.8	95	20.2
15	407	505	447	17.8	11.0	68.9	55.8	78.7	21.3	111	22.9
16	344	482	384	16.6	11.4	77.3	63.8	79.2	20.8	109	15.4
17	339	450	377	14.4	9.3	77.8	65.5	82.0	18.0	119	16.5
18	318	460	348	16.6	8.5	83.8	66.2	80.9	19.1	140	14.7
19	333	480	355	17.5	11.4	77.3	65.7	78.6	21.4	126	12.9
20	387	517	411	17.4	11.9	63.2	56.7	76.7	23.3	115	20.0
21	250	338	265	14.3	10.5	77.2	54.5	81.8	18.2	98	27.3

8. B-52G

OBS	AAB	AAR	ABK	AHR	ASU	ASD	CNX	CXR	CAN	CNR	HFN	LTO	LTR
1	7	0.9	299	37.5	5.3	6.3	21	3.1	305	0.38	5029.9	85	14.5
2	11	1.5	256	35.7	4.8	6.9	21	3.1	288	0.40	4958.7	72	12.3
3	9	1.0	417	47.2	5.9	7.6	7	0.9	293	0.33	6741.0	80	11.3
4	6	0.7	348	40.9	5.9	6.7	6	0.9	294	0.35	5723.1	66	10.3
5	10	1.1	390	41.2	6.3	6.[illegible]	16	2.0	277	0.29	6485.1	71	9.4
6	7	0.8	337	40.2	6.5	6.4	14	2.0	292	0.35	5400.9	73	11.2
7	11	1.4	252	31.9	5.6	6.5	6	1.0	259	0.33	5128.4	53	8.9
8	6	0.7	316	39.0	5.8	6.5	9	1.4	246	0.30	5304.4	64	10.7
9	8	1.1	249	34.0	5.3	6.6	9	1.6	166	0.23	4837.7	44	8.3
10	6	0.8	309	38.8	5.8	6.9	10	1.5	227	0.29	5456.0	52	8.4
11	5	0.8	237	36.0	5.0	6.9	8	1.4	173	0.26	4525.0	65	12.4
12	7	1.2	182	29.9	4.7	6.3	18	3.6	197	0.32	3808.0	56	13.8
13	6	0.8	244	31.0	6.0	6.5	23	3.3	234	0.30	5138.7	66	10.7
14	6	0.9	224	33.3	5.1	6.6	10	1.8	157	0.23	4447.9	63	12.5
15	14	1.8	238	31.4	5.8	7.2	15	2.5	181	0.24	5457.9	59	10.9
16	11	1.7	225	33.8	5.2	6.8	22	3.9	196	0.29	4553.0	50	9.8
17	14	1.8	282	36.0	6.1	6.9	18	2.9	224	0.29	5398.1	70	12.3
18	5	0.8	189	28.8	5.0	6.6	9	1.8	179	0.27	4308.9	69	14.7
19	10	1.5	198	29.7	5.3	6.3	12	2.4	151	0.23	4201.4	59	12.4
20	8	1.4	249	43.5	4.8	6.8	8	1.8	162	0.28	3877.6	41	10.4
21	10	2.2	180	39.0	3.8	6.7	17	4.7	221	0.48	3067.8	54	17.0

OBS	MHE	MHS	MHF	NMB	NMM	NMS	PMB	PMM	PMS	PSA	PSH
1	357471	448.0	71.1	7.1	9.9	9.0	1.4	3.8	10.3	151.7	112880
2	349063	486.2	70.4	6.9	9.0	6.1	0.4	4.5	8.9	150.6	101226
3	385631	436.7	57.2	7.7	12.0	4.7	0.3	4.1	6.0	148.8	110719
4	300092	353.0	52.4	8.0	8.8	7.7	0.7	4.4	7.4	144.3	103905
5	347376	367.2	53.6	7.8	10.0	5.3	0.8	4.3	5.8	150.5	108328
6	300518	358.2	55.6	7.2	10.3	5.6	1.5	4.4	8.4	129.4	93199
7	285241	361.5	55.6	5.5	9.3	4.7	0.6	3.5	9.9	141.3	105096
8	310827	383.7	58.6	6.4	10.0	5.2	2.0	4.8	8.7	138.8	103251
9	278099	379.9	57.5	6.4	9.8	4.0	1.6	5.3	11.0	137.5	98997
10	329771	414.3	60.4	7.5	10.4	6.3	1.3	4.8	10.7	136.2	101338
11	267714	406.9	59.2	5.1	10.0	7.1	1.1	4.8	7.7	130.7	94087
12	228803	376.3	60.1	4.9	9.8	6.0	1.2	5.2	6.5	128.1	95329
13	271986	346.0	52.9	5.1	10.2	4.4	0.3	4.2	4.3	130.0	96686
14	199468	296.8	44.8	4.8	10.6	5.7	0.2	2.8	2.9	131.4	88286
15	257753	340.5	47.2	4.8	12.2	5.9	0.2	5.2	2.6	129.4	96281
16	245059	368.5	53.8	4.8	8.9	5.2	0.8	4.4	4.1	127.9	92121
17	252337	321.9	46.7	6.9	10.0	5.7	0.2	4.0	4.3	129.2	96119
18	201887	307.3	46.9	7.1	9.2	4.4	0.7	3.0	3.7	130.4	93917
19	171569	257.6	40.8	5.1	10.0	6.0	0.2	3.7	2.9	124.8	92839
20	184586	322.1	47.6	3.7	9.3	5.6	0.3	4.1	4.1	119.5	88906
21	156881	340.3	51.1	5.7	9.6	7.1	0.4	3.5	4.3	122.6	88306

OBS	SAT	SFN	SSD	TNM	TNS	AFR	FMC	MCR	NMC	NFH	PMC
1	586	798	673	17.0	16.1	66.2	58.4	74.0	26.0	198	15.6
2	585	718	670	15.9	13.0	69.9	64.1	78.0	22.0	179	13.9
3	707	883	755	19.7	12.4	71.2	65.1	75.6	24.4	297	10.5
4	643	850	688	16.8	15.8	75.0	63.0	75.5	24.5	261	12.5
5	759	946	807	17.7	13.1	78.7	66.1	77.0	23.0	307	10.9
6	651	839	696	17.5	12.8	69.4	63.7	76.9	23.1	234	14.3
7	593	789	620	14.8	10.2	78.2	65.7	80.5	19.5	197	14.0
8	598	810	644	16.4	11.6	71.5	63.0	78.5	21.5	226	15.5
9	532	732	574	16.2	10.4	76.3	61.9	79.8	20.2	190	18.0
10	621	796	674	17.8	13.8	77.0	59.1	75.9	24.1	238	16.8
11	523	658	584	15.1	12.1	74.7	64.3	77.9	22.1	177	13.6
12	407	608	499	14.7	10.9	73.6	66.4	79.3	20.7	134	12.8
13	616	786	700	15.3	9.5	81.6	71.5	80.3	19.7	199	8.8
14	503	672	565	15.3	10.5	76.3	73.0	78.9	21.1	171	5.9
15	543	757	592	17.0	10.8	74.8	69.0	77.0	23.0	178	8.1
16	510	665	566	13.7	10.0	81.3	71.7	81.1	18.9	183	9.4
17	570	784	613	16.9	12.6	78.0	68.8	77.4	22.6	220	8.6
18	470	657	493	16.3	11.5	78.8	71.8	79.2	20.8	149	7.4
19	476	666	509	15.1	11.0	68.7	72.2	79.0	21.0	136	6.8
20	393	573	440	13.0	9.3	71.9	72.9	81.4	18.6	179	8.5
21	318	461	358	15.3	12.8	66.1	69.4	77.6	22.4	119	8.2

9. FB-111A

OBS	AAB	AAR	ABK	ABR	ASU	ASD	CNX	CXR	CAN	CNR	HFN	LTO
1	4	1.0	83	20.3	8.3	3.1	21	6.4	109	0.27	1255.8	21
2	4	0.9	90	20.7	9.0	2.9	15	4.2	86	0.20	1256.2	21
3	3	0.6	102	19.6	10.2	3.3	25	6.4	123	0.24	1696.3	20
4	4	0.7	97	17.8	11.2	3.1	18	4.8	136	0.25	1689.1	15
5	2	0.4	82	14.6	11.4	2.6	10	2.7	138	0.25	1481.6	10
6	5	1.0	68	13.1	10.7	3.3	19	5.0	162	0.31	1696.1	24
7	1	0.2	60	13.1	9.5	3.2	3	0.9	101	0.22	1446.9	28
8	1	0.2	88	18.4	9.7	3.2	8	2.3	233	0.49	1506.0	26
9	3	0.8	66	17.5	7.6	3.5	14	4.6	120	0.32	1335.3	12
10	4	0.9	72	15.8	9.4	3.5	10	2.8	170	0.37	1615.7	24
11	2	0.4	56	12.5	9.4	2.8	24	6.1	120	0.27	1265.3	18
12	2	0.5	62	16.6	7.6	3.3	31	9.9	141	0.38	1221.2	11
13	5	1.1	70	15.9	9.2	3.1	12	3.6	163	0.37	1374.4	15
14	3	0.6	63	12.6	10.7	3.3	13	3.4	128	0.26	1631.6	21
15	5	0.9	76	13.9	12.3	3.2	26	6.4	143	0.26	1751.9	22
16	0	0.0	62	13.3	10.3	3.3	18	4.8	147	0.31	1521.8	20
17	1	0.2	53	12.6	9.4	3.0	11	3.5	132	0.31	1252.1	15
18	1	0.2	42	8.3	11.2	2.9	8	2.6	101	0.20	1463.2	22
19	1	0.3	43	11.7	8.9	3.0	13	5.3	80	0.22	1093.9	15
20	0	0.0	41	12.8	10.4	2.7	2	0.9	91	0.28	866.0	15
21	0	0.0	18	14.8	5.7	3.4	2	2.2	60	0.49	411.5	3

OBS	LTR	MHE	MHS	MHF	NMB	NMM	NMS	PMB	PMM	PMS	PSA	PSH
1	8.1	64171	156.9	51.1	6.2	11.9	8.8	0.2	1.6	12.0	49.2	36584
2	7.6	51011	117.5	40.6	5.5	12.6	6.8	0.5	2.4	5.8	48.3	33603
3	5.9	64972	124.7	38.3	4.4	11.4	8.2	1.3	2.6	2.2	50.9	37862
4	4.3	51026	93.6	30.2	8.6	8.1	8.0	0.0	2.1	3.2	48.7	35042
5	2.9	60141	106.8	40.6	6.2	8.3	6.7	0.0	1.8	0.7	49.2	36596
6	6.9	27664	53.4	16.3	5.1	9.8	8.4	0.0	1.7	2.9	48.4	34860
7	8.8	45566	99.3	31.5	3.5	6.8	7.6	0.0	0.8	5.0	48.2	35852
8	7.9	56228	117.9	37.3	2.8	7.5	9.9	0.0	0.9	4.0	49.0	36434
9	4.3	42747	113.1	32.0	3.9	8.4	8.8	0.7	1.1	1.2	50.0	36000
10	7.6	51618	113.2	31.9	4.1	10.3	5.9	0.0	1.3	2.1	48.6	36170
11	5.7	46893	104.4	37.1	5.5	12.4	7.2	0.0	0.8	0.3	47.5	34221
12	4.6	38113	101.9	31.2	4.5	16.1	7.4	0.1	1.8	0.9	49.3	36651
13	5.6	52565	119.7	38.2	5.5	8.9	7.9	0.0	0.7	0.7	47.8	35598
14	6.8	49034	98.3	30.1	5.6	11.4	7.9	0.1	1.0	1.7	46.5	31266
15	6.4	56027	102.4	32.0	3.7	11.0	8.3	0.0	0.8	0.0	44.4	33019
16	6.2	56968	122.0	37.4	7.3	9.4	9.0	0.2	0.5	0.2	45.1	32488
17	5.2	51115	121.4	40.8	3.9	8.6	9.3	0.0	1.5	3.4	44.7	33275
18	7.8	26875	53.1	18.4	5.6	8.7	9.7	0.1	0.4	4.0	45.1	32497
19	6.6	24587	67.2	22.5	3.1	11.2	10.7	0.0	0.4	4.5	41.3	30750
20	7.5	24303	75.9	28.1	2.2	10.6	8.9	0.2	0.9	4.4	30.8	22884
21	3.4	22667	185.8	55.1	4.7	10.5	7.4	0.0	0.5	5.7	21.5	15450

OBS	SAT	SFN	SSD	TNM	TNS	AFR	FMC	MCR	NMC	NFH	PMC
1	259	409	330	18.1	15.0	71.1	59.3	73.1	26.9	59	13.8
2	278	434	356	18.1	12.3	76.7	66.3	75.1	24.9	69	8.8
3	340	521	389	15.3	12.5	80.4	70.0	76.0	23.9	82	6.1
4	347	545	376	16.7	16.7	66.0	69.9	75.3	24.7	64	5.3
5	347	563	374	14.5	12.9	73.2	76.3	78.9	21.1	60	2.6
6	348	518	378	14.9	13.5	83.8	72.1	76.7	23.3	57	4.6
7	317	459	340	10.3	11.1	80.0	76.3	82.1	17.9	48	5.8
8	331	477	348	10.3	12.7	87.5	74.9	79.8	20.2	77	4.9
9	279	378	305	12.2	12.7	78.8	76.0	79.0	21.0	52	3.0
10	317	456	354	14.4	10.0	81.9	76.2	79.7	20.3	59	3.4
11	318	449	395	17.9	12.7	71.4	73.7	74.9	25.1	40	1.2
12	238	374	313	20.7	11.9	74.2	69.1	71.9	28.1	46	2.9
13	270	439	329	18.9	13.4	80.0	76.2	77.8	22.3	56	1.4
14	310	499	387	16.9	13.5	88.9	72.4	75.2	24.8	56	2.7
15	343	547	406	14.7	12.0	81.6	76.1	77.0	23.0	62	0.8
16	322	467	373	16.6	16.2	82.3	73.5	74.4	25.6	51	0.9
17	287	421	312	12.5	13.2	86.8	73.4	78.2	21.8	46	4.9
18	282	506	312	14.3	15.3	76.2	71.4	76.0	24.0	32	4.6
19	229	366	247	14.2	13.7	81.4	70.1	75.1	24.9	35	4.9
20	200	320	214	12.9	11.1	82.9	72.8	78.3	21.7	34	5.5
21	89	122	92	15.2	12.1	88.9	71.3	77.4	22.6	16	6.2

Appendix B: SAS Computer Programs

Correlation Analysis

```
options ls=80;
data maint;
infile "aircraft data file";
  input aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf nmb nmm nms pmb pmm pms
  psa psh sat sfn ssd tnm tns afr fmc mcr nmc nfh pmc;
label aab='Air Aborts';
label aar='Air Abort Rate';
label abk='Aircraft Breaks';
label abr='Aircraft Break Rate';
label asu='Aircraft Sortie Utilization Rate';
label asd='Average Sortie Duration';
label cnx='Cancellations';
label cxr='Cancellation Rate';
label can='Cannibalizations';
label cnr='Cannibalization Rate';
label hfn='Aircraft Hours Flown';
label lto='Late Take-Offs';
label ltr='Late Take-Off Rate';
label mhe='Manhours Expended';
label mhs='Manhours Per Sortie';
label mhf='Manhours Per Flying Hour';
label nmb='Not Mission Capable Both Rate';
label nmm='Not Mission Capable Maintenance Rate';
label nms='Not Mission Capable Supply Rate';
label pmb='Partially Mission Capable Both Rate';
label pmm='Partially Mission Capable Maintenance Rate';
label pms='Partially Mission Capable Supply Rate';
label psa='Possessed Aircraft';
label psh='Possessed Hours';
label sat='Sorties Attempted';
label sfn='Sorties Flown';
label ssd='Sorties Scheduled';
label tnm='TNMCM Rate';
label tns='TNMCS Rate';
label afr='Aircraft Fix Rate';
label fmc='Full Mission Capable Rate';
label nmc='Not Mission Capable Rate';
label nfh='Number Fixed in 18 Hours';
label mcr='Mission Capable Rate';
label pmc='Partially Mission Capable Rate';
proc print;
  title '"Aircraft" Maintenance Data Set';
```

```
proc corr;
  var aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf nmb nmm nms pmb pmm pms
  psa psh sat sfn ssd tnm tns afr fmc mcr nmc nfh pmc;
  title '"Aircraft" Maintenance Variable Correlation Analysis';
```

<u>Stepwise Regression</u>

```
options ls=80;
data maint;
infile "aircraft data file";
  input aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf nmb nmm nms pmb pmm pms
  psa psh sat sfn ssd tnm tns afr fmc mcr nmc nfh pmc;
label aab='Air Aborts';
label aar='Air Abort Rate';
label abk='Aircraft Breaks';
label abr='Aircraft Break Rate';
label asu='Aircraft Sortie Utilization Rate';
label asd='Average Sortie Duration';
label cnx='Cancellations';
label cxr='Cancellation Rate';
label can='Cannibalizations';
label cnr='Cannibalization Rate';
label hfn='Aircraft Hours Flown';
label lto='Late Take-Offs';
label ltr='Late Take-Off Rate';
label mhe='Manhours Expended';
label mhs='Manhours Per Sortie';
label mhf='Manhours Per Flying Hour';
label nmb='Not Mission Capable Both Rate';
label nmm='Not Mission Capable Maintenance Rate';
label nms='Not Mission Capable Supply Rate';
label pmb='Partially Mission Capable Both Rate';
label pmm='Partially Mission Capable Maintenance Rate';
label pms='Partially Mission Capable Supply Rate':
label psa='Possessed Aircraft';
label psh='Possessed Hours';
label sat='Sorties Attempted';
label sfn='Sorties Flown';
label ssd='Sorties Scheduled';
label tnm='TNMCM Rate';
label tns='TNMCS Rate';
label afr='Aircraft Fix Rate';
label fmc='Full Mission Capable Rate';
label nmc='Not Mission Capable Rate';
label nfh='Number Fixed in 18 Hours';
label mcr='Mission Capable Rate';
label pmc='Partially Mission Capable Rate';
```

```
proc stepwise;
  model mcr=aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf psa psh sat sfn ssd afr nfh;
  title '3tepwise Model "aircraft" Maintenance Production Variables';
proc stepwise;
  model tns=aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf psa psh sat sfn ssd afr nfh;
  title 'Stepwise Model "aircraft" Maintenance Production Variables';
proc stepwise;
  model tnm=aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf psa psh sat sfn ssd afr nfh;
  title 'Stepwise Model "aircraft" Maintenance Production Variables';
```

Residual Analysis Program

```
options ls=80;
data maint;
infile "aircraft data file";
  input aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf nmb nmm nms pmb pmm pms
  psa psh sat sfn ssd tnm tns afr fmc mcr nmc nfh pmc;
label aab='Air Aborts';
label aar='Air Abort Rate';
label abk='Aircraft Breaks';
label abr='Aircraft Break Rate';
label asu='Aircraft Sortie Utilization Rate';
label asd='Average Sortie Duration';
label cnx='Cancellations';
label cxr='Cancellation Rate';
label can='Cannibalizations';
label cnr='Cannibalization Rate';
label hfn='Aircraft Hours Flown';
label lto='Late Take-Offs';
label ltr='Late Take-Off Rate';
label mhe='Manhours Expended';
label mhs='Manhours Per Sortie';
label mhf='Manhours Per Flying Hour';
label nmb='Not Mission Capable Both Rate';
label nmm='Not Mission Capable Maintenance Rate';
label nms='Not Mission Capable Supply Rate';
label pmb='Partially Mission Capable Both Rate';
label pmm='Partially Mission Capable Maintenance Rate';
label pms='Partially Mission Capable Supply Rate';
label psa='Possessed Aircraft';
label psh='Possessed Hours';
label sat='Sorties Attempted';
label sfn='Sorties Flown';
label ssd='Sorties Scheduled';
label tnm='TNMCM Rate';
label tns='TNMCS Rate';
label afr='Aircraft Fix Rate';
```

```
label fmc='Full Mission Capable Rate';
label nmc='Not Mission Capable Rate';
label nfh='Number Fixed in 18 Hours';
label mcr='Mission Capable Rate';
label pmc='Partially Mission Capable Rate';
proc reg;
  model mcr="regression independent variables" / r;
  plot student.*pred.='*' student.*cxr='*' student.*can='*' /
       student.*aab='*' student.*abr='*';
  title 'Residuals for "aircraft" Maintenance Production Variables';
  print cli;
  title 'Prediction Limits "aircraft" Maintenance Production Variables';
proc reg;
  model tns="regression independent variables" / r;
  plot student.*pred.='*' student.*cxr='*' student.*can='*' /
       student.*mhf='*' student.*afr='*';
  title 'Residuals for "aircraft" Maintenance Production Variables';
  print cli;
  title 'Prediction Limits "aircraft" Maintenance Production Variables';
proc reg;
  model tnm="regression independent variables" / r;
  plot student.*pred.='*' student.*cxr='*' student.*can='*' /
       student.*aab='*' student.*abr='*';
  title 'Residuals for "aircraft" Maintenance Production Variables';
  print cli;
  title 'Prediction Limits "aircraft" Maintenance Production Variables';
```

Supplemental Regression for Residual Modifications

1. KC-135R

```
options ls=80;
data maint;
infile "aircraft data file";
  input aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf nmb nmm nms pmb pmm pms
  psa psh sat sfn ssd tnm tns afr fmc mcr nmc nfh pmc;
sqmhf=(mhf*mhf);
label aab='Air Aborts';
label aar='Air Abort Rate';
label abk='Aircraft Breaks';
label abr='Aircraft Break Rate';
label asu='Aircraft Sortie Utilization Rate';
label asd='Average Sortie Duration';
label cnx='Cancellations';
label cxr='Cancellation Rate';
label can='Cannibalizations';
label cnr='Cannibalization Rate';
label hfn='Aircraft Hours Flown';
label lto='Late Take-Offs';
```

```
label ltr='Late Take-Off Rate';
label mhe='Manhours Expended';
label mhs='Manhours Per Sortie';
label mhf='Manhours Per Flying Hour';
label nmb='Not Mission Capable Both Rate';
label nmm='Not Mission Capable Maintenance Rate';
label nms='Not Mission Capable Supply Rate';
label pmb='Partially Mission Capable Both Rate';
label pmm='Partially Mission Capable Maintenance Rate';
label pms='Partially Mission Capable Supply Rate';
label psa='Possessed Aircraft';
label psh='Possessed Hours';
label sat='Sorties Attempted';
label sfn='Sorties Flown';
label ssd='Sorties Scheduled';
label tnm='TNMCM Rate';
label tns='TNMCS Rate';
label afr='Aircraft Fix Rate';
label fmc='Full Mission Capable Rate';
label nmc='Not Mission Capable Rate';
label nfh='Number Fixed in 18 Hours';
label mcr='Mission Capable Rate';
label pmc='Partially Mission Capable Rate';
proc reg;
  model tns=cxr can mhf sqmhf afr;
  title 'Regression Model "aircraft" Maintenance Production Variables';
```

2. RC-135V/N

```
options ls=80;
data maint;
infile "aircraft data file";
  input aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf nmb nmm nms pmb pmm pms
  psa psh sat sfn ssd tnm tns afr fmc mcr nmc nfh pmc;
sqcnr=(cnr*cnr);
sqcxr=(cxr*cxr);
label aab='Air Aborts';
label aar='Air Abort Rate';
label abk='Aircraft Breaks';
label abr='Aircraft Break Rate';
label asu='Aircraft Sortie Utilization Rate';
label asd='Average Sortie Duration';
label cnx='Cancellations';
label cxr='Cancellation Rate';
label can='Cannibalizations';
label cnr='Cannibalization Rate';
label hfn='Aircraft Hours Flown';
label lto='Late Take-Offs';
label ltr='Late Take-Off Rate';
label mhe='Manhours Expended';
```

```
label mhs='Manhours Per Sortie';
label mhf='Manhours Per Flying Hour';
label nmb='Not Mission Capable Both Rate';
label nmm='Not Mission Capable Maintenance Rate';
label nms='Not Mission Capable Supply Rate';
label pmb='Partially Mission Capable Both Rate';
label pmm='Partially Mission Capable Maintenance Rate';
label pms='Partially Mission Capable Supply Rate';
label psa='Possessed Aircraft';
label psh='Possessed Hours';
label sat='Sorties Attempted';
label sfn='Sorties Flown';
label ssd='Sorties Scheduled';
label tnm='TNMCM Rate';
label tns='TNMCS Rate';
label afr='Aircraft Fix Rate';
label fmc='Full Mission Capable Rate';
label nmc='Not Mission Capable Rate';
label nfh='Number Fixed in 18 Hours';
label mcr='Mission Capable Rate';
label pmc='Partially Mission Capable Rate';
proc reg;
  model tns=cnr sqcnr psh;
  title 'Regression Model "aircraft" Maintenance Production Variables';
proc reg;
  model tnm=sqcxr;
  title 'Regression Model "aircraft" Maintenance Production Variables';
```

3. FB-111A

```
options ls=80;
data maint;
infile "aircraft data file";
  input aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf nmb nmm nms pmb pmm pms
  psa psh sat sfn ssd tnm tns afr fmc mcr nmc nfh pmc;
sqafr=(afr*afr);
label aab='Air Aborts';
label aar='Air Abort Rate';
label abk='Aircraft Breaks';
label abr='Aircraft Break Rate';
label asu='Aircraft Sortie Utilization Rate';
label asd='Average Sortie Duration';
label cnx='Cancellations';
label cxr='Cancellation Rate';
label can='Cannibalizations';
label cnr='Cannibalization Rate';
label hfn='Aircraft Hours Flown';
label lto='Late Take-Offs';
label ltr='Late Take-Off Rate';
label mhe='Manhours Expended';
```

```
label mhs='Manhours Per Sortie';
label mhf='Manhours Per Flying Hour';
label nmb='Not Mission Capable Both Rate';
label nmm='Not Mission Capable Maintenance Rate';
label nms='Not Mission Capable Supply Rate';
label pmb='Partially Mission Capable Both Rate';
label pmm='Partially Mission Capable Maintenance Rate';
label pms='Partially Mission Capable Supply Rate';
label psa='Possessed Aircraft';
label psh='Possessed Hours';
label sat='Sorties Attempted';
label sfn='Sorties Flown';
label ssd='Sorties Scheduled';
label tnm='TNMCM Rate';
label tns='TNMCS Rate';
label afr='Aircraft Fix Rate';
label fmc='Full Mission Capable Rate';
label nmc='Not Mission Capable Rate';
label nfh='Number Fixed in 18 Hours';
label mcr='Mission Capable Rate';
label pmc='Partially Mission Capable Rate';
proc reg;
  model tns=afr sqafr;
  title 'Regression Model "aircraft" Maintenance Production Variables';
```

<u>Model Validation</u>

```
options ls=80;
data maint;
infile "aircraft data file";
  input aab aar abk abr asu asd cnx cxr can cnr
  hfn lto ltr mhe mhs mhf nmb nmm nms pmb pmm pms
  psa psh sat sfn ssd tnm tns afr fmc mcr nmc nfh pmc;
label aab='Air Aborts';
label aar='Air Abort Rate';
label abk='Aircraft Breaks';
label abr='Aircraft Break Rate';
label asu='Aircraft Sortie Utilization Rate';
label asd='Average Sortie Duration';
label cnx='Cancellations';
label cxr='Cancellation Rate';
label can='Cannibalizations';
label cnr='Cannibalization Rate';
label hfn='Aircraft Hours Flown';
label lto='Late Take-Offs';
label ltr='Late Take-Off Rate';
label mhe='Manhours Expended';
label mhs='Manhours Per Sortie';
label mhf='Manhours Per Flying Hour';
label nmb='Not Mission Capable Both Rate';
label nmm='Not Mission Capable Maintenance Rate';
```

```
label nms='Not Mission Capable Supply Rate';
label pmb='Partially Mission Capable Both Rate';
label pmm='Partially Mission Capable Maintenance Rate';
label pms='Partially Mission Capable Supply Rate';
label psa='Possessed Aircraft';
label psh='Possessed Hours';
label sat='Sorties Attempted';
label sfn='Sorties Flown';
label ssd='Sorties Scheduled';
label tnm='TNMCM Rate';
label tns='TNMCS Rate';
label afr='Aircraft Fix Rate';
label fmc='Full Mission Capable Rate';
label nmc='Not Mission Capable Rate';
label nfh='Number Fixed in 18 Hours';
label mcr='Mission Capable Rate';
label pmc='Partially Mission Capable Rate';
proc glm;
  model mcr="regression independent variables" / alpha=0.10 cli;
  title '90% Prediction Limits "aircraft" Maintenance Production
  Variables';
proc glm;
  model mcr="regression independent variables" / cli;
  title '95% Prediction Limits "aircraft" Maintenance Production
  Variables';
proc glm;
  model mcr="regression independent variables" / alpha=0.01 cli;
  title '99% Prediction Limits "aircraft" Maintenance Production
  Variables';
proc glm;
  model tns="regression independent variables" / alpha=0.10 cli;
  title '90% Prediction Limits "aircraft" Maintenance Production
  Variables';
proc glm;
  model tns="regression independent variables" / cli;
  title '95% Prediction Limits "aircraft" Maintenance Production
  Variables';
proc glm;
  model tns="regression independent variables" / alpha=0.01 cli;
  title '99% Prediction Limits "aircraft" Maintenance Production
  Variables';
proc glm;
  model tnm="regression independent variables" / alpha=0.10 cli;
  title '90% Prediction Limits "aircraft" Maintenance Production
  Variables';
proc glm;
  model tnm="regression independent variables" / cli;
  title '95% Prediction Limits "aircraft" Maintenance Production
  Variables';
proc glm;
  model tnm="regression independent variables" / alpha=0.01 cli;
  title '99% Prediction Limits "aircraft" Maintenance Production
  Variables';
```

Appendix C: HQ SAC\LGY Spreadsheet and SACP 66-17 Performance Measures

HQ SAC/LGY Spreadsheet

1) Air Aborts: Numeral

2) Air Abort Rate: (Air Aborts / Sorties Flown) X 100

3) Aircraft Breaks: Numeral

4) Aircraft Break Rate: (Aircraft Breaks / Sorties Flown) X 100

5) Aircraft Fix Rate: (Number Fixed in 18 Hrs / Aircraft Breaks) X 100

6) Aircraft Sortie
   Utilization Rate: (Sorties Flown / Possessed Aircraft) X 100

7) Average Sortie Duration: Hours Flown / Sorties Flown

8) Cancellations: Numeral

9) Cancellation Rate: (Cancellations / Sorties Scheduled) X 100

10) Cannibalizations: Numeral

11) Cannibalization Rate: (Cannibalizations / Sorties Flown) X 100

12) First Sortie After Ground Alert (FSAGA): Numeral

13) FSAGA
    Effectiveness:(FSAGA Points Attained / FSAGA Points Possible) X 100

14) Full Mission
    Capable (FMC) Rate: (FMC Hrs / Possessed Hrs) X 100

15) Engine Shutdowns: Numeral

16) Engine
    Shutdown Rate: (Engine Shutdowns / Hrs Flown X Total Engines) X 100

17) Hours Flown: Numeral

18) Late Take-Offs: Numeral

19) Late Take-Off Rate: (Late Take-Offs / Sorties Attempted) X 100

20) Manhours Expended: Numeral

21) Manhours Per Sortie: (Manhours Expended / Sorties Flown) X 100

22) Manhours Per Flying Hour: (Manhours Expended / Hours Flown) X 100

23) Mission Capable (MC) Rate: [(FMC + PMC Hrs) / Possessed Hrs] X 100

24) Not Mission
Capable (NMC) Rate: (Total NMC hrs / Possessed Hrs) X 100

* (Total NMC hours is the summation of NMC maintenance, NMC supply and NMC both)

25) NMC Maintenance (NMCM) Rate: (NMCM Hrs / Possessed Hrs) X 100

26) NMC Supply (NMCS) Rate: (NMCS Hrs / Possessed Hrs) X 100

27) NMC Both (NMCB) Rate: (NMCB Hrs / Possessed Hrs) X 100

28) Number Fixed in 18 Hours: Numeral

29) Partially Mission
Capable (PMC) Rate: (Total PMC Hrs / Possessed Hrs) X 100

* (Total PMC Hours is the summation of PMC maintenance, PMC supply and PMC both)

30) PMC Maintenance (PMCM) Rate: (PMCM Hrs / Possessed Hrs) X 100

31) PMC Supply (PMCS) Rate: (PMCS Hrs / Possessed Hrs) X 100

32) PMC Both (PMCB) Rate: (PMCB Hrs / Possessed Hrs) X 100

33) Possessed Aircraft: Numeral

34) Possessed Hours: Numeral

35) Sorties Attempted: Sorties Scheduled - Cancellations

36) Sorties Flown: Numeral

37) Sorties Scheduled: Numeral

38) Total NMCM (TNMCM) Rate: (NMCM Rate + NMCB Rate)

39) Total NMCS (TNMCS) Rate: (NMCS Rate + NMCB Rate)

SACR 66-17 (LGY:A1-1,A1-2,A1-3,A1-4)

NOTE: "*" indicates ratio defined in HQ SAC/LGY spreadsheet listing.

1) Cancellation Rate: *

2) Late Takeoff Rate: *

3) Materiel Air Abort Rate: See SACR 66-7, Vol 2.

4) Air Abort Rate: *

5) FSAGA Effectiveness: *

6) Cannibalization Rate: *

7) Man-Hours Per Flying Hour: *

8) Man-Hours Per Sortie: *

9) Direct Man-Hour
Utilization Rate: [MDC Direct Man-Hours /
(100 Assigned Man-Hours +
Total Overtime Hours)] X 100

10) Man-Hours Expended
Overtime Rate: (Total Overtime / 100 Labor Hrs Assigned) X 100

11) MC Rate: *

12) Short Range
Attack Missile
Reliability Rate: (Reliable Releases / Simulated Attempts) X 100

13) Base
Self-Sufficiency: [(Total Repairs + Contractor Repair) /
(Total Repairs + NRTS 1,2,3,4,5,6,7,8,9)] X 100

14) Average Delayed
Discrepancy
Rate Per Aircraft: [(Awaiting Maintenance + Awaiting Parts) /
Possessed Aircraft]

15) System
Reliability: (Number Code 1 / Number Codes 1-5) X 100

16) System
Capability: (Number Codes 1+2 / Number Codes 1-5) X 100

17) Engine Shutdown Rate: *

18) Unscheduled
Engine Change Rate: (Unscheduled Changes / Engines Changed) X 100

19) Test Cell
Reject Rate: (Test Cell Rejects / Engines Tested) X 100

20) NMC Rate: *

21) PMC Rate: *

22) Falling Object
Prevention (FOP) Rate: (Number of FOPs / Sorties Flown) X 100

23) 60-9 Maintenance
Scheduling
Effectiveness: [(Sorties Scheduled + Additions - Maint Canx) / (Sorties Scheduled + Additions)] X 100

24) Overall 60-9
Scheduling
Effectiveness: [(Sorties Scheduled + Additions - Deviations) / (Sorties Scheduled + Additions)] X 100

Appendix D: SAS Correlation Analysis Results

1. KC-135A/D/E/Q

	HFN	MHE	PSA	PSH	SAT	SFN
HFN Aircraft Hours Flown	1.00000 0.0	0.56967 0.0266	0.06246 0.8250	0.09747 0.7297	0.93292 0.0001	0.92243 0.0001
MHE Manhours Expended	0.56967 0.0266	1.00000 0.0	0.62734 0.0123	0.67182 0.0061	0.63971 0.0102	0.62565 0.0126
PSA Possessed Aircraft	0.06246 0.8250	0.62734 0.0123	1.00000 0.0	0.88452 0.0001	0.08397 0.7661	0.04922 0.8617
PSH Possessed Hours	0.09747 0.7297	0.67182 0.0061	0.88452 0.0001	1.00000 0.0	0.14462 0.6071	0.11595 0.6807
SAT Sorties Attempted	0.93292 0.0001	0.63971 0.0102	0.08397 0.7661	0.14462 0.6071	1.00000 0.0	0.98849 0.0001
SFN Sorties Flown	0.92243 0.0001	0.62565 0.0126	0.04922 0.8617	0.11595 0.6807	0.98849 0.0001	1.00000 0.0
SSD Sorties Scheduled	0.89619 0.0001	0.70029 0.0036	0.16016 0.5686	0.19908 0.4769	0.97723 0.0001	0.97063 0.0001
TNM TNMCM Rate	-0.46528 0.0805	-0.39961 0.1400	-0.62903 0.0120	-0.53240 0.0410	-0.44317 0.0980	-0.40358 0.1358
TNS TNMCS Rate	-0.59056 0.0205	-0.51781 0.0480	-0.56518 0.0281	-0.45169 0.0910	-0.62193 0.0133	-0.56619 0.0278
AFR Aircraft Fix Rate	0.07458 0.7917	-0.01866 0.9474	0.20210 0.4701	0.26528 0.3393	0.15354 0.5848	0.10409 0.7120
MCR Mission Capable Rate	0.61229 0.0153	0.52863 0.0128	0.58762 0.0212	0.53538 0.0397	0.63840 0.0104	0.59090 0.0204

	SSD	TNM	TNS	AFR	MCR
HFN	0.89619	-0.46528	-0.59056	0.07458	0.61229
Aircraft Hours Flown	0.0001	0.0805	0.0205	0.7917	0.0153
MHE	0.70029	-0.39961	-0.51781	-0.01866	0.52863
Manhours Expended	0.0036	0.1400	0.0480	0.9474	0.0428
PSA	0.16016	-0.62903	-0.56518	0.20210	0.58762
Possessed Aircraft	0.5686	0.0120	0.0281	0.4701	0.0212
PSH	0.19908	-0.53240	-0.45169	0.26528	0.53538
Possessed Hours	0.4769	0.0410	0.0910	0.3393	0.0397
SAT	0.97723	-0.44317	-0.62193	0.15354	0.63840
Sorties Attempted	0.0001	0.0980	0.0133	0.5848	0.0104
SFN	0.97063	-0.40358	-0.56619	0.10409	0.59090
Sorties Flown	0.0001	0.1358	0.0278	0.7120	0.0204
SSD	1.00000	-0.43499	-0.62498	0.10698	0.61622
Sorties Scheduled	0.0	0.1051	0.0127	0.7043	0.0144
TNM	-0.43499	1.00000	0.89326	-0.63628	-0.93404
TNMCM Rate	0.1051	0.0	0.0001	0.0108	0.0001
TNS	-0.62498	0.89326	1.00000	-0.64096	-0.97189
TNMCS Rate	0.0127	0.0001	0.0	0.0100	0.0001
AFR	0.10698	-0.63628	-0.64096	1.00000	0.66381
Aircraft Fix Rate	0.7043	0.0108	0.0100	0.0	0.0070
MCR	0.61622	-0.93404	-0.97189	0.66381	1.00000
Mission Capable Rate	0.0144	0.0001	0.0001	0.0070	0.0

2. KC-135R

	ASD	CNX	CXR	LTR
ASD	1.00000	0.59127	0.52355	0.48250
Average Sortie Duration	0.0	0.0203	0.0452	0.0685
CNX	0.59127	1.00000	0.96994	0.57505
Cancellations	0.0203	0.0	0.0001	0.0249
CXR	0.52355	0.96994	1.00000	0.61139
Cancellation Rate	0.0452	0.0001	0.0	0.0154
LTR	0.48250	0.57505	0.61139	1.00000
Late Take-Off Rate	0.0685	0.0249	0.0154	0.0

	ASD	CNX	CXR	LTR
TNM TNMCM Rate	0.57588 0.0247	0.59745 0.0187	0.63982 0.0102	0.44814 0.0939
TNS TNMCS Rate	0.40436 0.1349	0.68762 0.0046	0.76346 0.0009	0.38736 0.1537
MCR Mission Capable Rate	-0.58542 0.0219	-0.77820 0.0006	-0.82796 0.0001	-0.51756 0.0482

	TNM	TNS	MCR
ASD Average Sortie Duration	0.57588 0.0247	0.40436 0.1349	-0.58542 0.0219
CNX Cancellations	0.59745 0.0187	0.68762 0.0046	-0.77820 0.0006
CXR Cancellation Rate	0.63982 0.0102	0.76346 0.0009	-0.82796 0.0001
LTR Late Take-Off Rate	0.44814 0.0939	0.38736 0.1537	-0.51756 0.0482
TNM TNMCM Rate	1.00000 0.0	0.74882 0.0013	-0.90789 0.0001
TNS TNMCS Rate	0.74882 0.0013	1.00000 0.0	-0.93171 0.0001
MCR Mission Capable Rate	-0.90789 0.0001	-0.93171 0.0001	1.00000 0.0

3. RC-135V/N

	CXR	PSH	TNM	TNS	MCR
CXR Cancellation Rate	1.00000 0.0	-0.20021 0.4743	0.55942 0.0301	0.45990 0.0846	-0.41605 0.1230
PSH Possessed Hours	-0.20021 0.4743	1.00000 0.0	-0.31443 0.2537	-0.55316 0.0324	0.50831 0.0530
TNM TNMCM Rate	0.55942 0.0301	-0.31443 0.2537	1.00000 0.0	0.74437 0.0015	-0.85270 0.0001

	CXR	PSH	TNM	TNS	MCR
TNS TNMCS Rate	0.45990 0.0846	-0.55316 0.0324	0.74437 0.0015	1.00000 0.0	-0.93275 0.0001
MCR Mission Capable Rate	-0.41605 0.1230	0.50831 0.0530	-0.85270 0.0001	-0.93275 0.0001	1.00000 0.0

4. EC-135A/C/G/L/N/Y

	ABK	ABR	CXR	HFN	MHE
ABK Aircraft Breaks	1.00000 0.0	0.81267 0.0002	-0.30199 0.2740	0.06760 0.8108	-0.47470 0.0738
ABR Aircraft Break Rate	0.81267 0.0002	1.00000 0.0	0.09925 0.7249	-0.50064 0.0573	-0.73964 0.0016
CXR Cancellation Rate	-0.30199 0.2740	0.09925 0.7249	1.00000 0.0	-0.75034 0.0013	-0.23483 0.3995
HFN Aircraft Hours Flown	0.06760 0.8108	-0.50064 0.0573	-0.75034 0.0013	1.00000 0.0	0.55368 0.0322
MHE Manhours Expended	-0.47470 0.0738	-0.73964 0.0016	-0.23483 0.3995	0.55368 0.0322	1.00000 0.0
SFN Sorties Flown	-0.04231 0.8810	-0.60841 0.0161	-0.62948 0.0119	0.94620 0.0001	0.63976 0.0102
TNM TNMCM Rate	0.20877 0.4553	0.52126 0.0463	0.52566 0.0442	-0.65143 0.0085	-0.55959 0.0301
TNS TNMCS Rate	0.64179 0.0099	0.85050 0.0001	0.12631 0.6538	-0.53333 0.0406	-0.61695 0.0143
MCR Mission Capable Rate	-0.48707 0.0656	-0.79694 0.0004	-0.37248 0.1715	0.67424 0.0058	0.78529 0.0005
NFH Number Fixed in 18 Hours	0.72429 0.0023	0.79784 0.0004	-0.03979 0.8880	-0.25912 0.3510	-0.50465 0.0550

	SFN	TNM	TNS	MCR	NFH
ABK Aircraft Breaks	-0.04231 0.8810	0.20877 0.4553	0.64179 0.0099	-0.48707 0.0656	0.72429 0.0023
ABR Aircraft Break Rate	-0.60841 0.0161	0.52126 0.0463	0.85050 0.0001	-0.79694 0.0004	0.79784 0.0004
CXR Cancellation Rate	-0.62948 0.0119	0.52566 0.0442	0.12631 0.6538	-0.37248 0.1715	-0.03979 0.8880
HFN Aircraft Hours Flown	0.94620 0.0001	-0.65143 0.0085	-0.53333 0.0406	0.67424 0.0058	-0.25912 0.3510
MHE Manhours Expended	0.63976 0.0102	-0.55959 0.0301	-0.61695 0.0143	0.78529 0.0005	-0.50465 0.0559
SFN Sorties Flown	1.00000 0.0	-0.61780 0.0141	-0.54377 0.0361	0.70157 0.0036	-0.37548 0.1678
TNM TNMCM Rate	-0.61780 0.0141	1.00000 0.0	0.57460 0.0251	-0.85802 0.0001	0.58603 0.0217
TNS TNMCS Rate	-0.54377 0.0361	0.57460 0.0251	1.00000 0.0	-0.85540 0.0001	0.65039 0.0087
MCR Mission Capable Rate	0.70157 0.0036	-0.85802 0.0001	-0.85540 0.0001	1.00000 0.0	-0.67129 0.0061
NFH Number Fixed in 18 Hours	-0.37548 0.1678	0.58603 0.0217	0.65039 0.0087	-0.67129 0.0061	1.00000 0.0

5. E-4B

	PSA	PSH	TNM	TNS	MCR
PSA Possessed Aircraft	1.00000 0.0	0.96509 0.0001	-0.52495 0.0445	-0.14732 0.6003	0.44974 0.0926
PSH Possessed Hours	0.96509 0.0001	1.00000 0.0	-0.55553 0.0316	-0.17918 0.5229	0.46321 0.0821
TNM TNMCM Rate	-0.52495 0.0445	-0.55553 0.0316	1.00000 0.0	0.33172 0.2271	-0.91651 0.0001

	PSA	PSH	TNM	TNS	MCR
TNS TNMCS Rate	-0.14732 0.6003	-0.17918 0.5229	0.33172 0.2271	1.00000 0.0	-0.50657 0.0540
MCR Mission Capable Rate	0.44974 0.0926	0.46321 0.0821	-0.91651 0.0001	-0.50657 0.0540	1.00000 0.0

6. B-1B

	ABR	TNM	TNS	MCR
ABR Aircraft Break Rate	1.00000 0.0	0.53185 0.0413	-0.17260 0.5385	-0.49313 0.0618
TNM TNMCM Rate	0.53185 0.0413	1.00000 0.0	-0.42869 0.1109	-0.70532 0.0033
TNS TNMCS Rate	-0.17260 0.5385	-0.42869 0.1109	1.00000 0.0	-0.24794 0.3729
MCR Mission Capable Rate	-0.49313 0.0618	-0.70532 0.0033	-0.24794 0.3729	1.00000 0.0

7. B-52H

	TNM	TNS	AFR	MCR
TNM TNMCM Rate	1.00000 0.0	-0.13213 0.6388	-0.18774 0.5028	-0.43383 0.1062
TNS TNMCS Rate	-0.13213 0.6388	1.00000 0.0	-0.54256 0.0366	-0.81015 0.0003
AFR Aircraft Fix Rate	-0.18774 0.5028	-0.54256 0.0366	1.00000 0.0	0.58944 0.0208
MCR Mission Capable Rate	-0.43383 0.1062	-0.81015 0.0003	0.58944 0.0208	1.00000 0.0

8. B-52G

	ABK	ABR	ASU	ASD
ABK Aircraft Breaks	1.00000 0.0	0.94203 0.0001	0.70339 0.0034	0.43913 0.1015
ABR Aircraft Break Rate	0.94203 0.0001	1.00000 0.0	0.49804 0.0588	0.48070 0.0697
ASU Aircraft Sortie Utilization Rate	0.70339 0.0034	0.49804 0.0588	1.00000 0.0	0.16720 0.5514
ASD Average Sortie Duration	0.43913 0.1015	0.48070 0.0697	0.16720 0.5514	1.00000 0.0
CAN Cannibalizations	0.70190 0.0035	0.62070 0.0135	0.43947 0.1012	0.02635 0.9257
CNR Cannibalization Rate	0.31142 0.2585	0.31684 0.2499	0.01878 0.9470	-0.16965 0.5455
HFN Aircraft Hours Flown	0.91415 0.0001	0.77962 0.0006	0.75762 0.0011	0.62957 0.0119
LTO Late Take-Offs	0.52764 0.0432	0.55492 0.0318	0.20098 0.4726	0.15794 0.5740
MHE Manhours Expended	0.77861 0.0006	0.75544 0.0011	0.34724 0.2048	0.39562 0.1444
PSA Possessed Aircraft	0.60659 0.0165	0.57125 0.0261	0.05621 0.8423	0.25242 0.3641
PSH Possessed Hours	0.64638 0.0092	0.55481 0.0318	0.23538 0.3984	0.22225 0.4259
SAT Sorties Attempted	0.90823 0.0001	0.76102 0.0010	0.79109 0.0004	0.40306 0.1363
SFN Sorties Flown	0.90827 0.0001	0.72090 0.0024	0.85380 0.0001	0.29971 0.2778
SSD Sorties Scheduled	0.87246 0.0001	0.73501 0.0018	0.71611 0.0027	0.36455 0.1816
TNM TNMCM Rate	0.86276 0.0001	0.84462 0.0001	0.59652 0.0189	0.61652 0.0144
TNS TNMCS Rate	0.54167 0.0370	0.60517 0.0168	0.13338 0.6356	0.03176 0.9105

	ABK	ABR	ASU	ASD
AFR Aircraft Fix Rate	-0.20270 0.4688	-0.36947 0.1753	0.18722 0.5040	0.04915 0.8619
MCR Mission Capable Rate	-0.62154 0.0134	-0.68314 0.0050	-0.25947 0.3504	-0.32733 0.2337
NFH Number Fixed in 18 Hours	0.96899 0.0001	0.86768 0.0001	0.75537 0.0011	0.45772 0.0862

	CAN	CNR	HFN	LTO
ABK Aircraft Breaks	0.70190 0.0035	0.31142 0.2585	0.91415 0.0001	0.52764 0.0432
ABR Aircraft Break Rate	0.62070 0.0135	0.31684 0.2499	0.77962 0.0006	0.55492 0.0318
ASU Aircraft Sortie Utilization Rate	0.43947 0.1012	0.01878 0.9470	0.75762 0.0011	0.20098 0.4726
ASD Average Sortie Duration	0.02635 0.9257	-0.16965 0.5455	0.62957 0.0119	0.15794 0.5740
CAN Cannibalizations	1.00000 0.0	0.87123 0.0001	0.58666 0.0215	0.68586 0.0048
CNR Cannibalization Rate	0.87123 0.0001	1.00000 0.0	0.15893 0.5716	0.59764 0.0186
HFN Aircraft Hours Flown	0.58666 0.0215	0.15893 0.5716	1.00000 0.0	0.40487 0.1344
LTO Late Take-Offs	0.68586 0.0048	0.59764 0.0186	0.40487 0.1344	1.00000 0.0
MHE Manhours Expended	0.79310 0.0004	0.59784 0.0186	0.72160 0.0024	0.56806 0.0272
PSA Possessed Aircraft	0.70544 0.0033	0.56300 0.0289	0.55268 0.0326	0.51014 0.0520
PSH Possessed Hours	0.70946 0.0031	0.51196 0.0511	0.62154 0.0134	0.43343 0.1065
SAT Sorties Attempted	0.70097 0.0036	0.29487 0.2860	0.92969 0.0001	0.47125 0.0762

	CAN	CNR	HFN	LTO
SFN	0.70135	0.26711	0.92839	0.41108
Sorties Flown	0.0036	0.3359	0.0001	0.1280
SSD	0.75248	0.39618	0.87878	0.59002
Sorties Scheduled	0.0012	0.1438	0.0001	0.0206
TNM	0.49873	0.16151	0.84488	0.44808
TNMCM Rate	0.0584	0.5653	0.0001	0.0939
TNS	0.64310	0.57829	0.33016	0.54537
TNMCS Rate	0.0097	0.0239	0.2294	0.0355
AFR	-0.43858	-0.56754	0.02326	-0.59285
Aircraft Fix Rate	0.1020	0.0273	0.9344	0.0198
MCR	-0.53102	-0.37961	-0.49429	-0.62215
Mission Capable Rate	0.0417	0.1628	0.0611	0.0133
NFH	0.60751	0.17862	0.93591	0.38713
Number Fixed in 18 Hours	0.0163	0.5242	0.0001	0.1540

	MHE	PSA	PSH	SAT
ABK	0.77861	0.60659	0.64638	0.90823
Aircraft Breaks	0.0006	0.0165	0.0092	0.0001
ABR	0.75544	0.57125	0.55481	0.76102
Aircraft Break Rate	0.0011	0.0261	0.0318	0.0010
ASU	0.34724	0.05621	0.23538	0.79109
Aircraft Sortie Utilization Rate	0.2048	0.8423	0.3984	0.0004
ASD	0.39562	0.25242	0.22225	0.40306
Average Sortie Duration	0.1444	0.3641	0.4259	0.1363
CAN	0.79310	0.70544	0.70946	0.70097
Cannibalizations	0.0004	0.0033	0.0031	0.0036
CNR	0.59784	0.56300	0.51196	0.29487
Cannibalization Rate	0.0186	0.0289	0.0511	0.2860
HFN	0.72160	0.55268	0.62154	0.92969
Aircraft Hours Flown	0.0024	0.0326	0.0134	0.0001
LTO	0.56806	0.51014	0.43343	0.47125
Late Take-Offs	0.0272	0.0520	0.1065	0.0762

	MHE	PSA	PSH	SAT
MHE Manhours Expended	1.00000 0.0	0.81390 0.0002	0.84157 0.0001	0.74778 0.0013
PSA Possessed Aircraft	0.81390 0.0002	1.00000 0.0	0.86536 0.0001	0.58515 0.0219
PSH Possessed Hours	0.84157 0.0001	0.86536 0.0001	1.00000 0.0	0.59412 0.0195
SAT Sorties Attempted	0.74778 0.0013	0.58515 0.0219	0.59412 0.0195	1.00000 0.0
SFN Sorties Flown	0.70226 0.0035	0.56119 0.0295	0.65487 0.0081	0.95725 0.0001
SSD Sorties Scheduled	0.78577 0.0005	0.62188 0.0133	0.61178 0.0154	0.97396 0.0001
TNM TNMCM Rate	0.72716 0.0021	0.44929 0.0929	0.53198 0.0412	0.72069 0.0024
TNS TNMCS Rate	0.60139 0.0177	0.59668 0.0189	0.54530 0.0355	0.39034 0.1503
AFR Aircraft Fix Rate	-0.41159 0.1274	-0.33182 0.2270	-0.27142 0.3278	0.04628 0.8699
MCR Mission Capable Rate	-0.61074 0.0156	-0.47983 0.0703	-0.51236 0.0508	-0.43180 0.1080
NFH Number Fixed in 18 Hours	0.69523 0.0040	0.54860 0.0342	0.59671 0.0189	0.93790 0.0001

	SFN	SSD	TNM	TNS
ABK Aircraft Breaks	0.90827 0.0001	0.87246 0.0001	0.86276 0.0001	0.54167 0.0370
ABR Aircraft Break Rate	0.72090 0.0024	0.73501 0.0018	0.84462 0.0001	0.60517 0.0168
ASU Aircraft Sortie Utilization Rate	0.85380 0.0001	0.71611 0.0027	0.59652 0.0189	0.13338 0.6356
ASD Average Sortie Duration	0.29971 0.2778	0.36455 0.1816	0.61652 0.0144	0.03176 0.9105

	SFN	SSD	TNM	TNS
CAN Cannibalizations	0.70135 0.0036	0.75248 0.0012	0.43873 0.0584	0.64310 0.0097
CNR Cannibalization Rate	0.26711 0.3359	0.39618 0.1438	0.16151 0.5653	0.57829 0.0239
HFN Aircraft Hours Flown	0.92839 0.0001	0.87878 0.0001	0.84488 0.0001	0.33016 0.2294
LTO Late Take-Offs	0.41108 0.1280	0.59002 0.0206	0.44808 0.0939	0.54537 0.0355
MHE Manhours Expended	0.70226 0.0035	0.78577 0.0005	0.72716 0.0021	0.60139 0.0177
PSA Possessed Aircraft	0.56119 0.0295	0.62188 0.0133	0.44929 0.0929	0.59668 0.0189
PSH Possessed Hours	0.65407 0.0081	0.61178 0.0154	0.53198 0.0412	0.54530 0.0355
SAT Sorties Attempted	0.95725 0.0001	0.97396 0.0001	0.72069 0.0024	0.39034 0.1503
SFN Sorties Flown	1.00000 0.0	0.91142 0.0001	0.73837 0.0017	0.40454 0.1347
SSD Sorties Scheduled	0.91142 0.0001	1.00000 0.0	0.69945 0.0037	0.44328 0.0979
TNM TNMCM Rate	0.73837 0.0017	0.69945 0.0037	1.00000 0.0	0.47705 0.0722
TNS TNMCS Rate	0.40454 0.1347	0.44328 0.0979	0.47705 0.0722	1.00000 0.0
AFR Aircraft Fix Rate	0.01657 0.9533	-0.01110 0.9687	-0.31246 0.2569	-0.54190 0.0369
MCR Mission Capable Rate	-0.45964 0.0848	-0.47398 0.0743	-0.73030 0.0020	-0.88214 0.0001
NFH Number Fixed in 18 Hours	0.93027 0.0001	0.88843 0.0001	0.79853 0.0004	0.43233 0.1075

	AFR	MCR	NFH
ABK	-0.20270	-0.62154	0.96899
Aircraft Breaks	0.4688	0.0134	0.0001
ABR	-0.36947	-0.68314	0.86768
Aircraft Break Rate	0.1753	0.0050	0.0001
ASU	0.18722	-0.25947	0.75537
Aircraft Sortie Utilization Rate	0.5040	0.3504	0.0011
ASD	0.04915	-0.32733	0.45772
Average Sortie Duration	0.8619	0.2337	0.0862
CAN	-0.43858	-0.53102	0.60751
Cannibalizations	0.1020	0.0417	0.0163
CNR	-0.56754	-0.37961	0.17862
Cannibalization Rate	0.0273	0.1628	0.5242
HFN	0.02326	-0.49429	0.93591
Aircraft Hours Flown	0.9344	0.0611	0.0001
LTO	-0.59285	-0.62215	0.38713
Late Take-Offs	0.0198	0.0133	0.1540
MHE	-0.41159	-0.61074	0.69523
Manhours Expended	0.1274	0.0156	0.0040
PSA	-0.33182	-0.47983	0.54860
Possessed Aircraft	0.2270	0.0703	0.0342
PSH	-0.27142	-0.51236	0.59671
Possessed Hours	0.3278	0.0508	0.0199
SAT	0.04628	-0.43180	0.93790
Sorties Attempted	0.8699	0.1080	0.0001
SFN	0.01657	-0.45964	0.93027
Sorties Flown	0.9533	0.0848	0.0001
SSD	-0.01110	-0.47398	0.88843
Sorties Scheduled	0.9687	0.0743	0.0001
TNM	-0.31246	-0.73030	0.79853
TNMCM Rate	0.2569	0.0020	0.0004
TNS	-0.54190	-0.88214	0.43233
TNMCS Rate	0.0369	0.0001	0.1075

	AFR	MCR	NFH
AFR Aircraft Fix Rate	1.00000 0.0	0.57237 0.0258	0.04204 0.8818
MCR Mission Capable Rate	0.57237 0.0258	1.00000 0.0	-0.49822 0.0587
NFH Number Fixed in 18 Hours	0.04204 0.8818	-0.49822 0.0587	1.00000 0.0

9. FB-111A

	CNX	CXR	SAT	TNM	TNS	MCR
CNX Cancellations	1.00000 0.0	0.97025 0.0001	-0.19169 0.4937	0.64527 0.0094	0.18196 0.5163	-0.81031 0.0002
CXR Cancellation Rate	0.97025 0.0001	1.00000 0.0	-0.38476 0.1567	0.67742 0.0055	0.17037 0.5438	-0.83433 0.0001
SAT Sorties Attempted	-0.19169 0.4937	-0.38476 0.1567	1.00000 0.0	-0.51568 0.0491	0.06757 0.8109	0.42964 0.1100
TNM TNMCM Rate	0.64527 0.0094	0.67742 0.0055	-0.51568 0.0491	1.00000 0.0	0.30037 0.2767	-0.86358 0.0001
TNS TNMCS Rate	0.18196 0.5163	0.17037 0.5438	0.06757 0.8109	0.30037 0.2767	1.00000 0.0	-0.44362 0.0976
MCR Mission Capable Rate	-0.81031 0.0002	-0.83483 0.0001	0.42964 0.1100	-0.86358 0.0001	-0.44362 0.0976	1.00000 0.0

Appendix E: SAS Stepwise Regression Results

1. KC-135A/D/E/Q

Stepwise Procedure for Dependent Variable MCR

R-square = 0.98744065   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	6	69.88051671	11.64675278	104.83	0.0001
Error	8	0.88881662	0.11110208		
Total	14	70.76933333			

Variable	Parameter Estimate	Standard Error	TypeII Sum of Squares	F	Prob>F
INTERCEP	38.04622195	2.38444222	28.23600728	254.59	0.0001
CXR	0.75877404	0.22775737	1.23311115	11.10	0.0104
HFN	0.00097751	0.00012426	6.87570170	61.89	0.0001
LTO	-0.01446777	0.00832972	0.33517006	3.02	0.1206
MHS	-0.04293796	0.01124485	1.61993435	14.58	0.0051
PSA	0.10113728	0.01137570	8.78189237	79.04	0.0001
AFR	0.24319189	0.02170248	13.95088169	125.57	0.0001

Stepwise Procedure for Dependent Variable TNS

R-square = 0.95600282   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	5	36.80355913	7.36071183	39.11	0.0001
Error	9	1.69377421	0.18819713		
Total	14	38.49733333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	51.32581732	3.60488601	38.15062715	202.72	0.0001
ASD	-1.32164121	0.58975956	0.94512700	5.02	0.0518
PSA	-0.10388919	0.01885950	5.71075456	30.34	0.0004
PSH	0.00007197	0.00002006	2.42385710	12.88	0.0058
SSD	-0.00496849	0.00066817	10.40623053	55.29	0.0001
AFR	-0.19832473	0.02556992	11.32160112	60.16	0.0001

Stepwise Procedure for Dependent Variable TNM

R-square = 0.92365682 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	20.06182621	5.01545655	30.25	0.0001
Error	10	1.65817379	0.16581738		
Total	14	21.72000000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	33.94379560	2.65581546	27.08663547	163.35	0.0001
CNX	-0.02507325	0.01484972	0.47273205	2.85	0.1222
MHF	0.15368301	0.02731124	5.25048013	31.66	0.0002
PSA	-0.07321202	0.01027244	8.42262418	50.79	0.0001
AFR	-0.11659759	0.02498530	3.61110365	21.78	0.0009

2. KC-135R

Stepwise Procedure for Dependent Variable MCR

R-square = 0.92828033 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	89.16070720	22.29017680	32.36	0.0001
Error	10	6.88862614	0.68886261		
Total	14	96.04933333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	80.19298923	2.16064641	948.93839839	1377.54	0.0001
AAB	-0.19724352	0.07776295	4.43192739	6.43	0.0295
ABR	0.56448108	0.27571787	2.88736522	4.19	0.0678
CXR	-3.18676447	0.31588910	70.10730464	101.77	0.0001
CAN	0.06275161	0.01199742	18.84546883	27.36	0.0004

Stepwise Procedure for Dependent Variable TNS

R-square = 0.93067079 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	36.31105169	9.07776292	33.56	0.0001
Error	10	2.70494831	0.27049483		
Total	14	39.01600000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	3.26669287	2.66361146	0.40684954	1.50	0.2481
CXR	1.67561051	0.17293874	25.39338065	93.88	0.0001
CAN	-0.02287072	0.00810153	2.15567771	7.97	0.0181
MHF	0.10380524	0.02754043	3.84287464	14.21	0.0037
AFR	0.03676311	0.01570155	1.48285423	5.48	0.0412

Stepwise Procedure for Dependent Variable TNM

R-square = 0.74857707 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	31.36837357	7.84209339	7.44	0.0048
Error	10	10.53562643	1.05356264		
Total	14	41.90400000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	14.93912778	2.67206841	32.93181750	31.26	0.0002
AAB	0.19902250	0.09616933	4.51223273	4.28	0.0653
ABR	-0.60323452	0.34097985	3.29742793	3.13	0.1073
CXR	1.90416680	0.39065961	25.03071943	23.76	0.0006
CAN	-0.04359398	0.01483719	9.09515694	8.63	0.0148

3. RC-135V/N

Stepwise Procedure for Dependent Variable MCR

R-square = 0.25837765   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	205.11155058	205.11155058	4.53	0.0530
Error	13	588.73244942	45.28711149		
Total	14	793.84400000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	-11.03150188	36.69764957	4.09229949	0.09	0.7665
PSH	0.01010084	0.00474624	205.11155058	4.53	0.0530

Stepwise Procedure for Dependent Variable TNS

R-square = 0.59685876   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	517.32693185	172.44231062	5.43	0.0155
Error	11	349.42240148	31.76567286		
Total	14	866.74933333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	80.64843652	32.29190732	198.13562505	6.24	0.0296
ABR	0.47477789	0.24837145	116.07419879	3.65	0.0823
CNR	51.79067828	29.05015648	100.96347839	3.18	0.1022
PSH	-0.01002689	0.00401020	198.58993114	6.25	0.0295

Stepwise Procedure for Dependent Variable TNM

R-square = 0.31295350   C(p) =   .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	69.51323133	69.51323133	5.92	0.0301
Error	13	152.60676867	11.73898221		
Total	14	222.12000000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	22.48229325	1.69478334	2065.77628609	175.98	0.0001
CXR	0.66039551	0.27138485	69.51323133	5.92	0.0301

4. EC-135A/C/G/L/N/Y

Stepwise Procedure for Dependent Variable MCR

R-square = 0.85793639   C(p) =   .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	468.29371166	117.07342792	15.10	0.0003
Error	10	77.54362167	7.75436217		
Total	14	545.83733333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	-77.81496054	52.54836611	17.00410781	2.19	0.1695
CNR	61.84632562	36.18240968	22.65577447	2.92	0.1182
HFN	0.06939123	0.01748021	122.19741418	15.76	0.0026
MHS	0.26833042	0.09567562	60.99346653	7.87	0.0186
NFH	-0.21846782	0.12694103	22.96767434	2.96	0.1160

Stepwise Procedure for Dependent Variable TNS

R-square = 0.72335314 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	190.55243469	190.55243469	33.99	0.0001
Error	13	72.87689865	5.60591528		
Total	14	263.42933333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	-0.99820323	3.31430657	0.50850955	0.09	0.7680
ABR	0.53177720	0.09121069	190.55243469	33.99	0.0001

Stepwise Procedure for Dependent Variable TNM

R-square = 0.61097171 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	2	196.82412973	98.41206486	9.42	0.0035
Error	12	125.32520361	10.44376697		
Total	14	322.14933333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	36.66665744	13.84495590	73.25152269	7.01	0.0212
HFN	-0.02302460	0.00801483	86.18912545	8.25	0.0140
NFH	0.27671494	0.11533699	60.11532244	5.76	0.0336

5. K-4R

Stepwise Procedure for Dependent Variable MCR

R-square = 0.67618578   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	790.81910210	197.70477553	5.22	0.0156
Error	10	378.71023123	37.87102312		
Total	14	1169.52933333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	-9.70800897	21.61828708	7.63703563	0.20	0.6630
ASD	11.59708123	3.78416945	355.68314531	9.39	0.0119
MHE	-0.00093483	0.00049423	135.49257598	3.58	0.0878
SFN	0.95309276	0.28209364	432.30553322	11.42	0.0070
AFR	0.20830702	0.07822212	268.56887550	7.09	0.0238

Stepwise Procedure for Dependent Variable TNS

R-square = 0.40499789   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	2	383.15878597	191.57939298	4.08	0.0444
Error	12	562.91721403	46.90976784		
Total	14	946.07600000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	-8.97003221	6.62014600	86.12240595	1.84	0.2004
LTR	0.44688887	0.24872680	151.43183706	3.23	0.0976
MHF	0.18475454	0.07808874	262.58912669	5.60	0.0357

Stepwise Procedure for Dependent Variable TNM

R-square = 0.44768891   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	2	560.53045670	280.26522835	4.86	0.0284
Error	12	691.52554330	57.62712861		
Total	14	1252.05600000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	79.66043329	19.26564540	985.24714338	17.10	0.0014
PSH	-0.02189886	0.00830735	400.44679037	6.95	0.0217
AFR	-0.13117397	0.07546091	174.13185883	3.02	0.1077

6. B-1B

Stepwise Procedure for Dependent Variable MCR

R-square = 0.60859503   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	61.66284844	15.41571211	3.89	0.0371
Error	10	39.65715156	3.96571516		
Total	14	101.32000000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	48.76243266	5.58909758	301.86228820	76.12	0.0001
ABR	-0.50036148	0.16976295	34.45112719	8.69	0.0146
CNX	-0.09931590	0.05771574	11.74277154	2.96	0.1160
LTR	0.79725166	0.34572386	21.08888816	5.32	0.0438
NFH	0.08617415	0.03563780	23.18749194	5.85	0.0362

Stepwise Procedure for Dependent Variable TNS

R-square = 0.16579056 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	7.70152411	7.70152411	2.58	0.1320
Error	13	38.75180923	2.98090840		
Total	14	46.45333333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	39.94011536	3.00301100	527.29471203	176.89	0.0001
CAN	-0.01039062	0.00646439	7.70152411	2.58	0.1320

Stepwise Procedure for Dependent Variable TNM

R-square = 0.28286384 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	61.63603169	61.63603169	5.13	0.0413
Error	13	156.26396831	12.02030525		
Total	14	217.90000000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	13.66899532	6.96063531	46.35439589	3.86	0.0713
ABR	0.45615772	0.20144451	61.63603169	5.13	0.0413

7. B-52H

Stepwise Procedure for Dependent Variable MCR

R-square = 0.34744220 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	16.82315151	16.82315151	6.92	0.0208
Error	13	31.59684849	2.43052681		
Total	14	48.42000000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	59.66591214	6.71477254	191.90680369	78.96	0.0001
AFR	0.25184359	0.09572545	16.82315151	6.92	0.0208

Stepwise Procedure for Dependent Variable TNS

R-square = 0.61927384 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	46.48104277	15.49368092	5.96	0.0115
Error	11	28.57629056	2.59784460		
Total	14	75.05733333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	51.69792248	9.07849851	84.24250971	32.43	0.0001
LTO	-0.09587816	0.05314832	8.45421663	3.25	0.0987
MHE	-0.00006511	0.00003067	11.70401527	4.51	0.0573
AFR	-0.35578411	0.10179774	31.73291772	12.22	0.0050

Stepwise Procedure for Dependent Variable TNM

R-square = 0.17854837   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	5.95232663	5.95232663	2.83	0.1166
Error	13	27.38500671	2.10653898		
Total	14	33.33733333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	15.86436812	1.05010733	480.78142589	228.23	0.0001
CNX	0.10944459	0.06510820	5.95232663	2.83	0.1166

8. B-52G

Stepwise Procedure for Dependent Variable MCR

R-square = 0.58524529   C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	2	30.18070922	15.09035461	8.47	0.0051
Error	12	21.38862411	1.78238534		
Total	14	51.56933333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	72.66935753	8.55907242	128.48453034	72.09	0.0001
ABR	-0.21910116	0.08025072	13.28556533	7.45	0.0183
AFR	0.17509608	0.09453547	6.11455479	3.43	0.0887

Stepwise Procedure for Dependent Variable TNS

R-square = 0.41357868   C(p) =   .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	22.34153125	22.34153125	9.17	0.0097
Error	13	31.67846875	2.43680529		
Total	14	54.02000000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	6.48096319	1.93128689	27.44140567	11.26	0.0052
CAN	0.02390236	0.00789395	22.34153125	9.17	0.0097

Stepwise Procedure for Dependent Variable TNM

R-square = 0.85122927   C(p) =   .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	22.45883308	7.48627769	20.98	0.0001
Error	11	3.92516692	0.35683336		
Total	14	26.38400000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	3.92490893	3.12267164	0.56373108	1.58	0.2348
ABK	0.03091081	0.00982523	3.53183982	9.90	0.0093
ASD	1.25992810	0.50596579	2.21265989	6.20	0.0300
MFH	-0.02245105	0.01359281	0.97346575	2.73	0.1268

9. FB-111A

Stepwise Procedure for Dependent Variable TNS

R-square = 0.88662924 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	4	93.48027572	23.37006893	19.55	0.0001
Error	10	11.95305761	1.19530576		
Total	14	105.43333333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	85.26275582	9.66487610	93.02617466	77.83	0.0001
CXR	-1.06911154	0.13250199	77.81803525	65.10	0.0001
MHF	-0.09441557	0.04042323	6.52085161	5.46	0.0416
PSA	-0.82283627	0.32863756	7.49327156	6.27	0.0312
PSH	0.00112162	0.00030033	16.67103759	13.95	0.0039

Stepwise Procedure for Dependent Variable TNS

R-square = 0.21753092 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	7.37342819	7.37342819	3.61	0.0797
Error	13	26.52257181	2.04019783		
Total	14	33.89600000			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	21.87171224	4.75465640	43.17174199	21.16	0.0005
AFR	-0.11499420	0.06048913	7.37342819	3.61	0.0797

Stepwise Procedure for Dependent Variable TNM

R-square = 0.86351847 C(p) = .

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	6	111.66099825	18.61016638	8.44	0.0041
Error	8	17.64833508	2.20604189		
Total	14	129.30933333			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	-4.08321842	18.64723348	0.10577674	0.05	0.8322
AAR	3.59195585	1.59816128	11.14383120	5.05	0.0548
ASD	-3.14474941	1.85614252	6.33232508	2.87	0.1287
CNX	-1.28473194	0.77421895	6.07450927	2.75	0.1356
CXR	4.87101738	2.65326199	7.43520319	3.37	0.1037
SAT	-0.05772736	0.02340772	13.41710553	6.08	0.0389
SSD	0.12219413	0.04865347	13.91511430	6.31	0.0363

Appendix F: Residual Analysis Results

1. KC-135R

Model: MODEL1

Dependent Variable: TNS TNMCS Rate

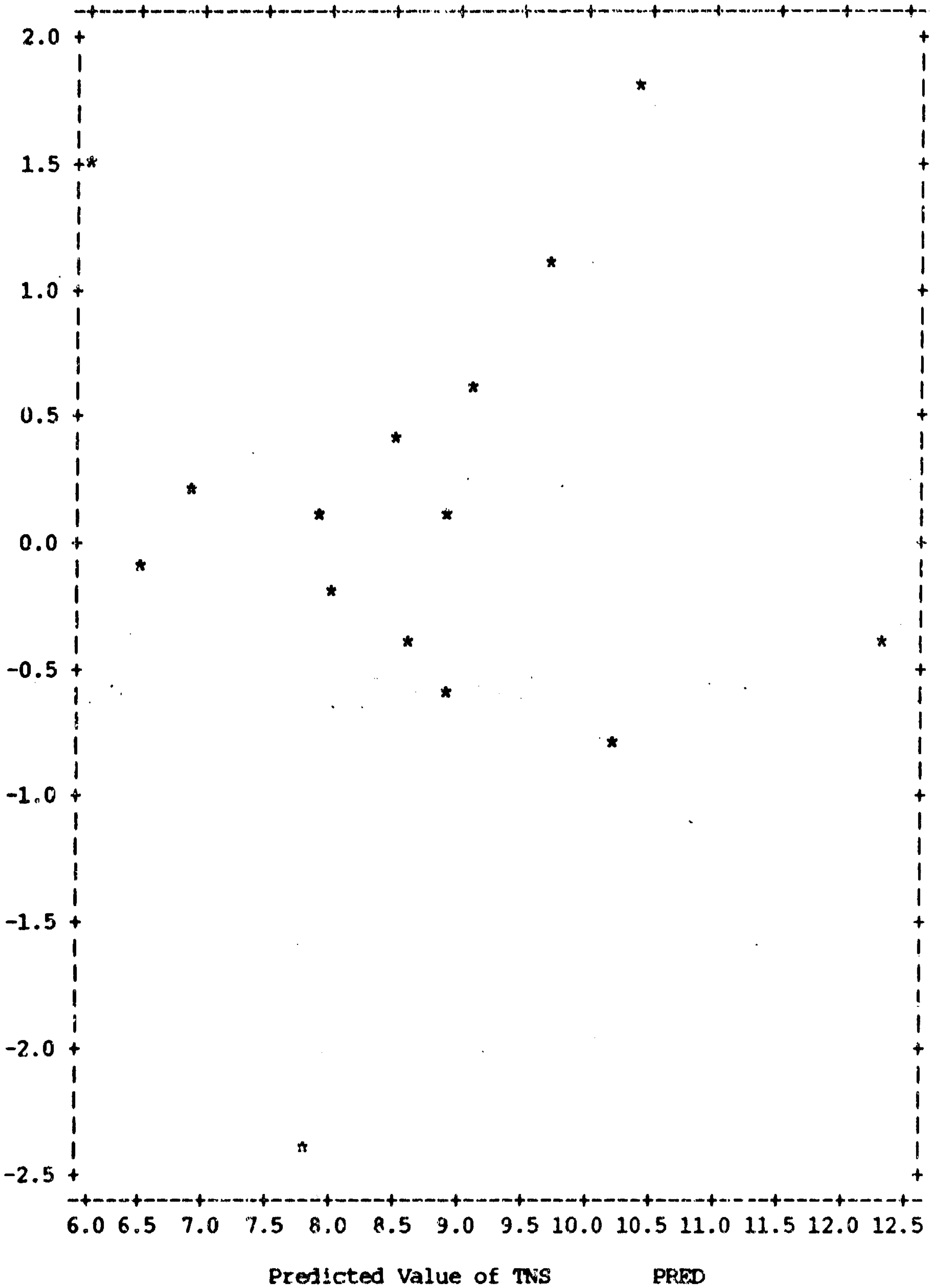
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	4	36.31105	9.07776	33.560	0.0001
Error	10	2.70495	0.27049		
C Total	14	39.01600			

Root MSE	0.52009	R-square	0.9307
Dep Mean	8.66000	Adj R-sq	0.9029
C.V.	6.00567		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	3.266693	2.66361146	1.226	0.2481
CXR	1	1.675611	0.17293874	9.689	0.0001
CAN	1	-0.022871	0.00810153	-2.823	0.0181
MHF	1	0.103805	0.02754043	3.769	0.0037
AFR	1	0.036763	0.01570155	2.341	0.0412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-2.0
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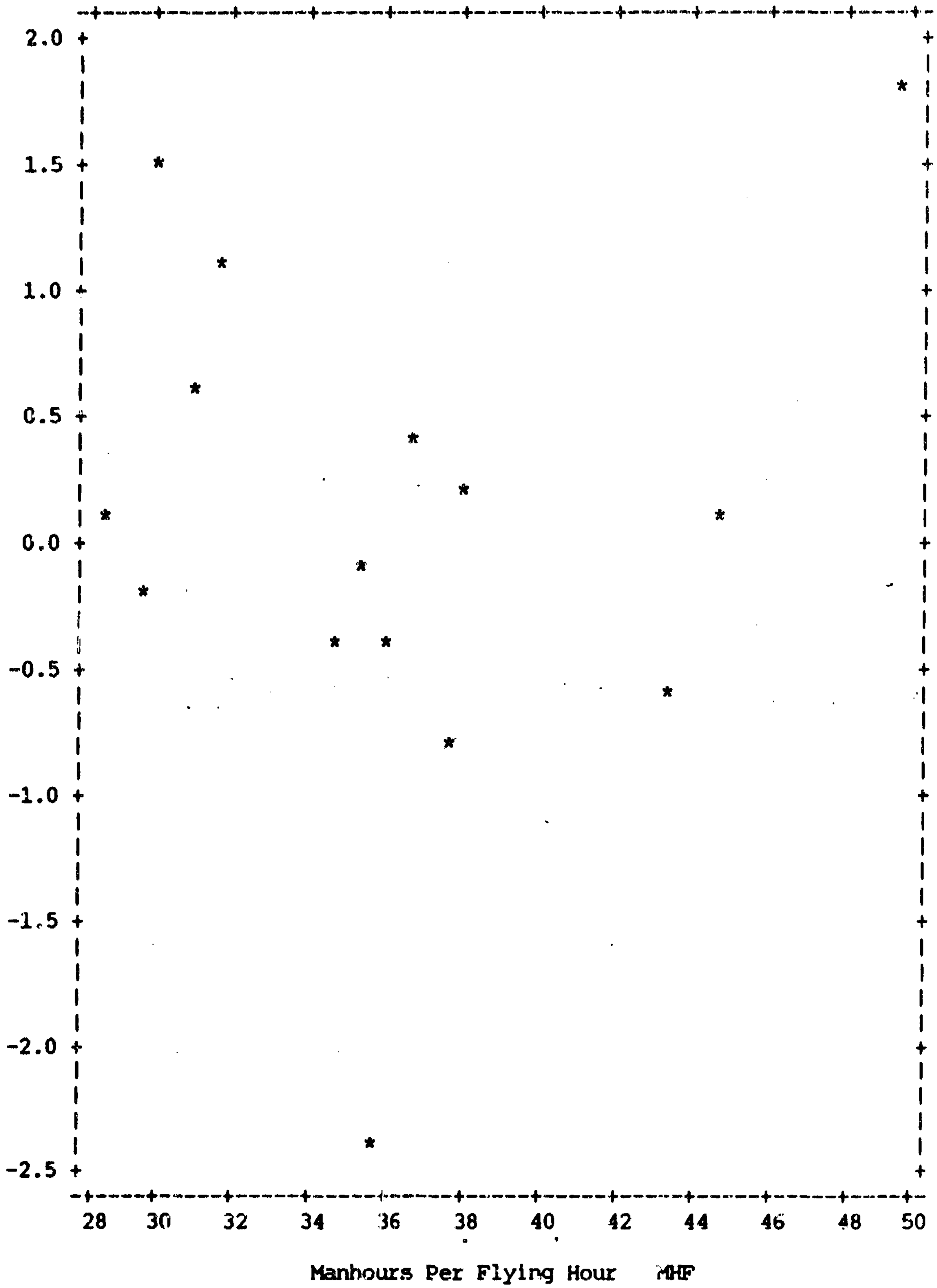
Predicted Value of TNS PRED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Manhours Per Flying Hour MHF

2. RC-135V/N

Dependent Variable: TNS   TNMCS Rate

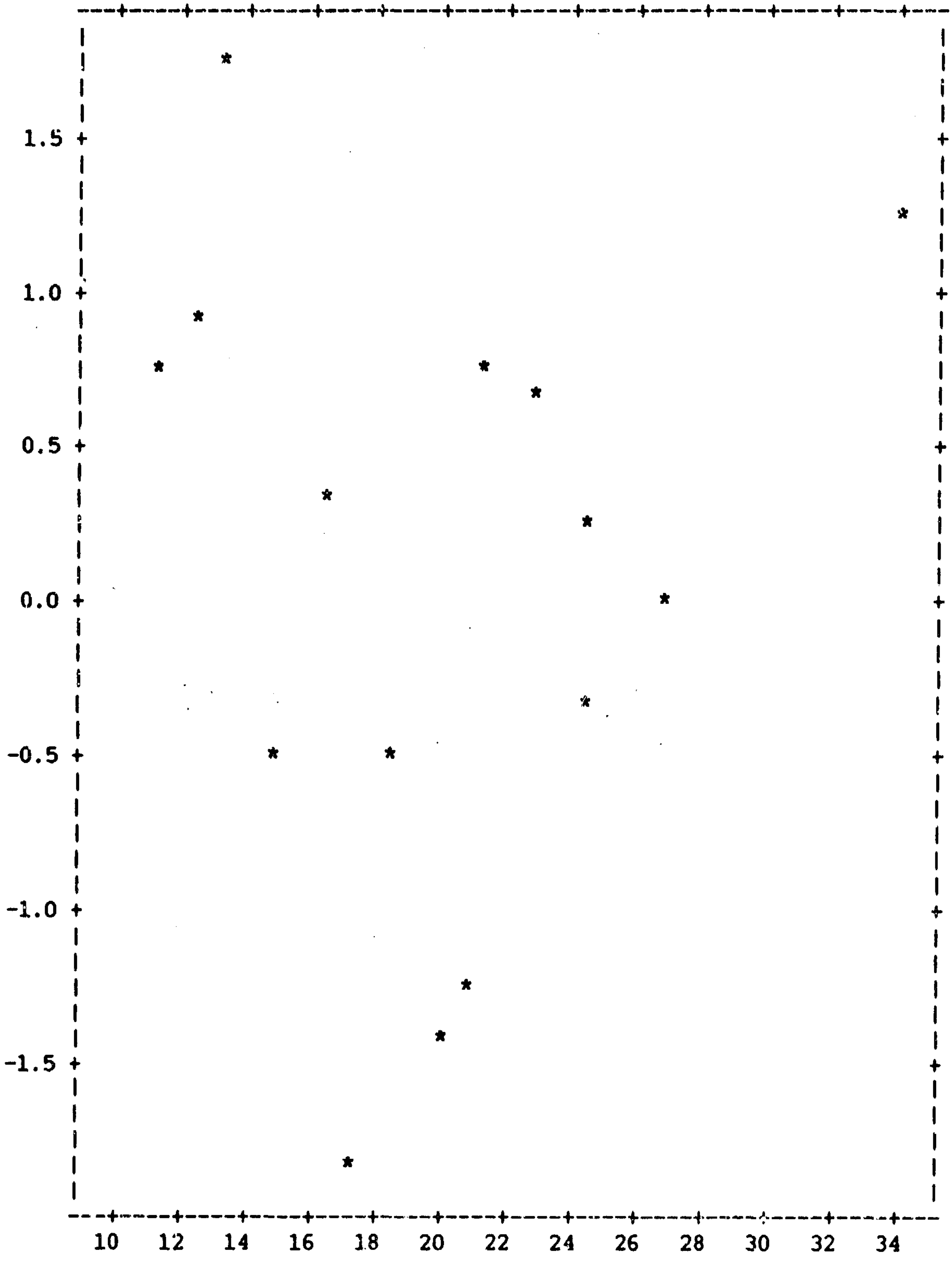
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	3	517.32693	172.44231	5.429	0.0155
Error	11	349.42240	31.76567		
C Total	14	866.74933			

Root MSE	5.63610	R-square	0.5969
Dep Mean	19.82667	Adj R-sq	0.4869
C.V.	28.42689		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	80.648437	32.29190732	2.497	0.0296
ABR	1	0.474778	0.24837145	1.912	0.0823
CNR	1	51.790678	29.05015648	1.783	0.1022
PSH	1	-0.010027	0.00401020	-2.500	0.0295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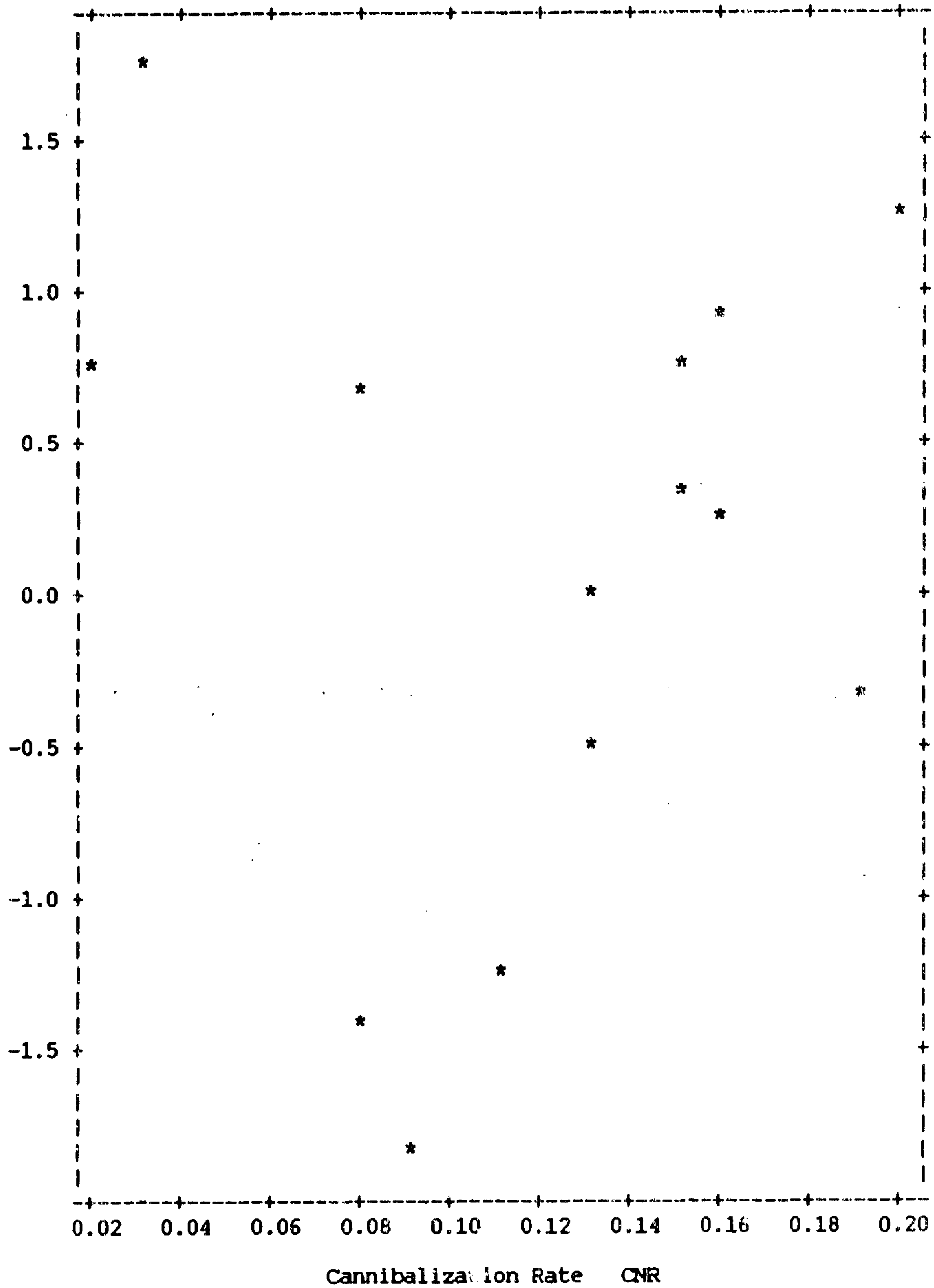
Predicted Value of TNS PRED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0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
Cannibalization Rate CNR

Dependent Variable: TNM TNMCM Rate

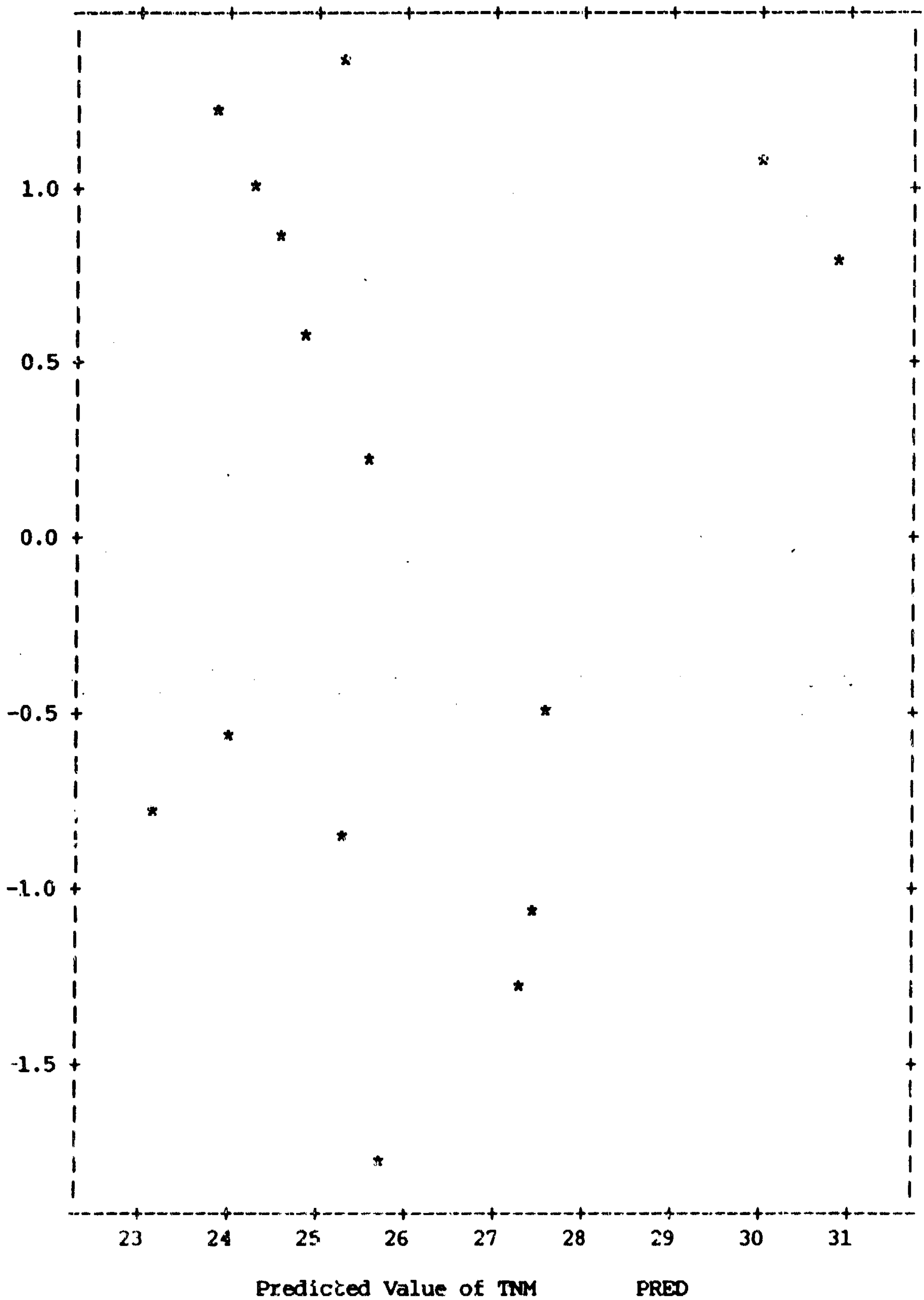
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	69.51323	69.51323	5.922	0.0301
Error	13	152.60677	11.73898		
C Total	14	222.12000			

Root MSE	3.42623	R-square	0.3130
Dep Mean	26.00000	Adj R-sq	0.2601
C.V.	13.17777		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	22.482293	1.69478334	13.266	0.0001
CXR	1	0.660396	0.27138485	2.433	0.0301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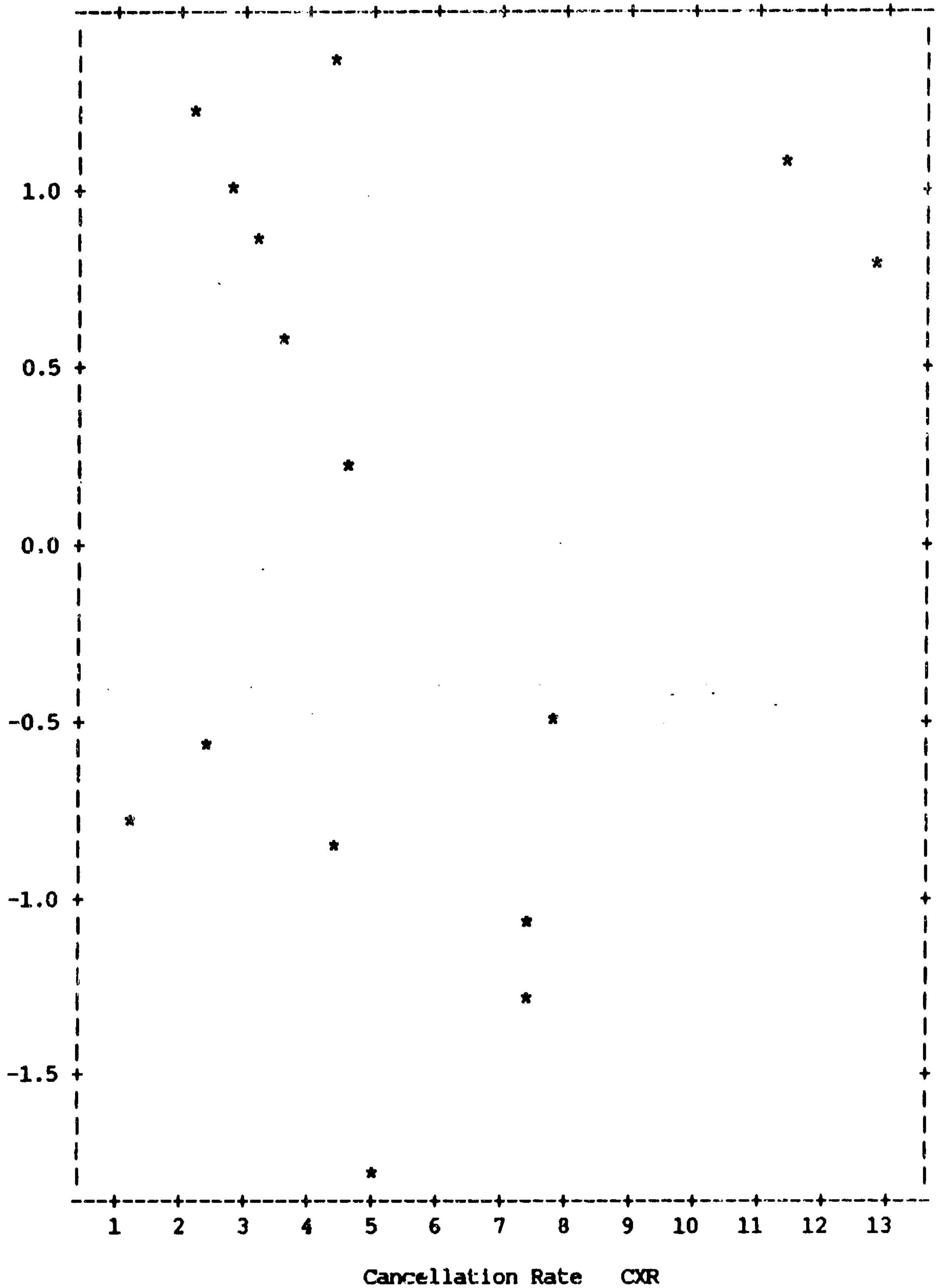
24
25
26
27
28
29
30
31
Predicted Value of TNM PRED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-1.5
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2
3
4
5
6
7
8
9
10
11
12
13
Cancellation Rate CXR

3. FB-111A

Dependent Variable: TNS TNMCS Rate

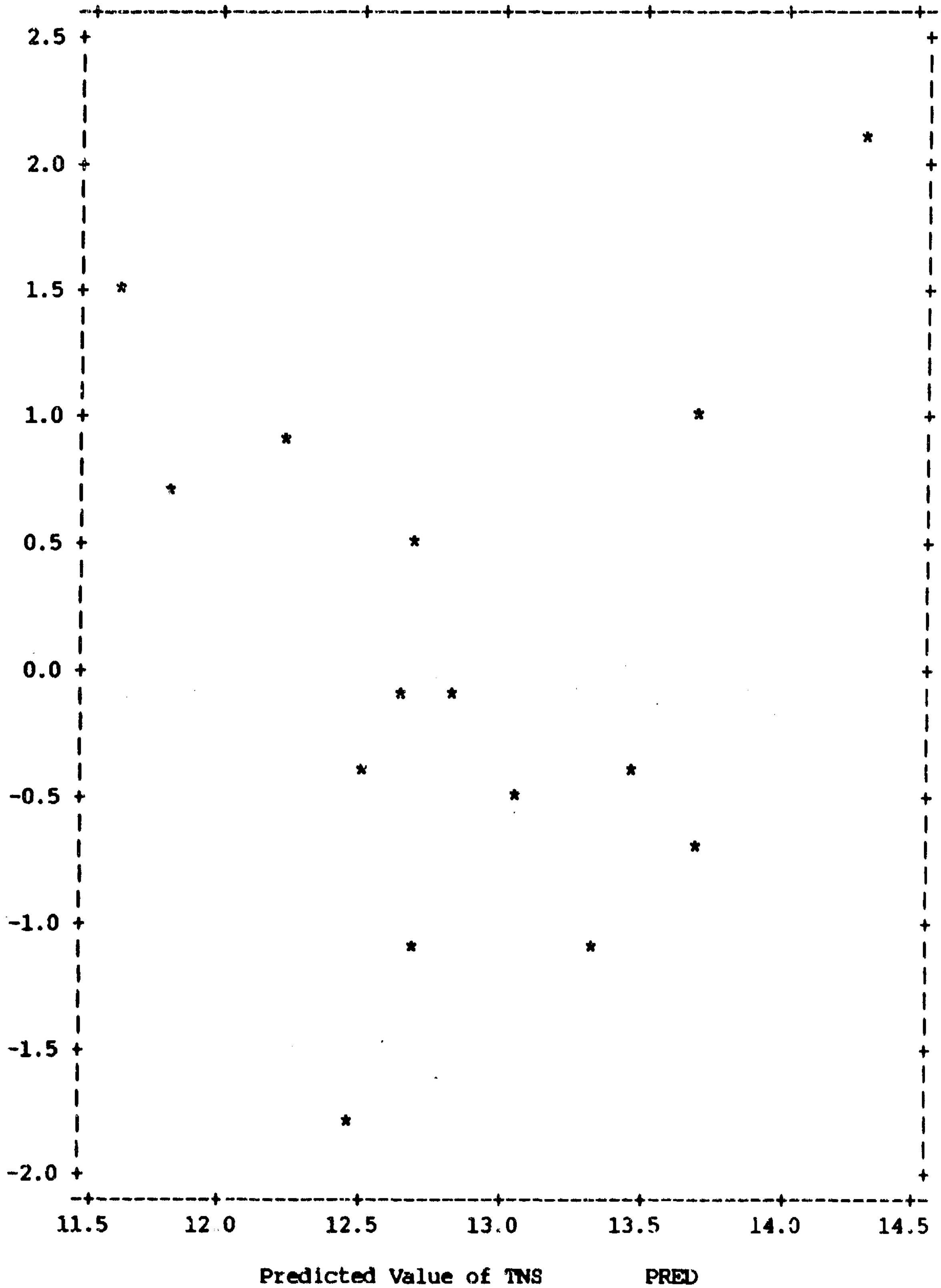
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	7.37343	7.37343	3.614	0.0797
Error	13	26.52257	2.04020		
C Total	14	33.89600			

Root MSE	1.42835	R-square	0.2175
Dep Mean	12.86000	Adj R-sq	0.1573
C.V.	11.10696		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	21.871712	4.75465640	4.600	0.0005
AFR	1	-0.114994	0.06048913	-1.901	0.0797



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2.0
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1.0
0.5
0.0
-0.5
-1.0
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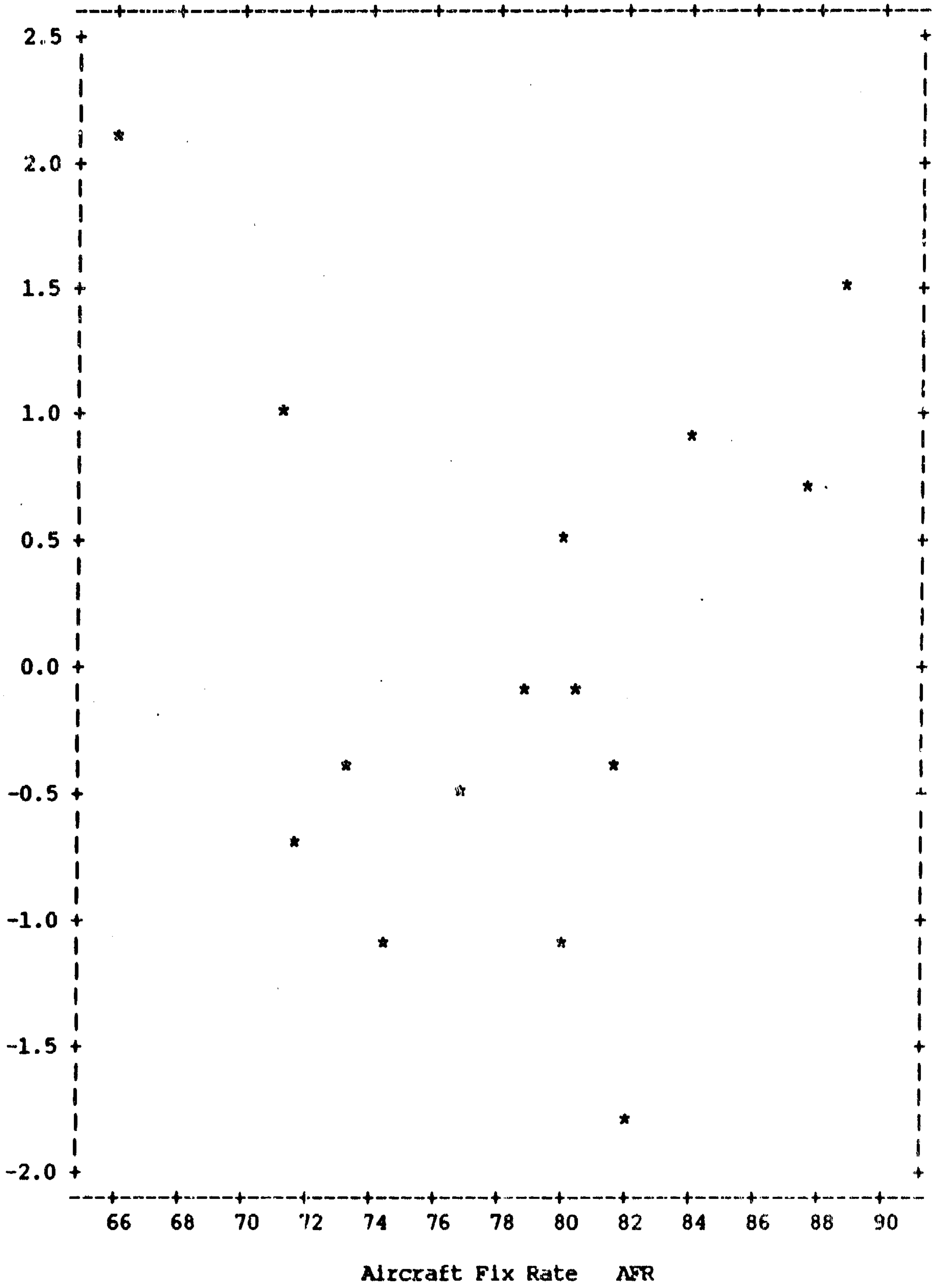
-2.0
11.5
12.0
12.5
13.0
13.5
14.0
14.5
Predicted Value of TNS
PRED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1.5
1.0
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-0.5
-1.0
-1.5
-2.0
66 68 70 72 74 76 78 80 82 84 86 88 90
Aircraft Fix Rate AFR

Appendix G: Regression Model Validation Results

1. KC-135A/D/E/Q

90% Confidence Interval for Predicted Value

Dependent Variable: MCR   MC Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	81.70468820	80.57573101
			.	82.83364539
17	*	.	86.39390852	85.17230803
			.	87.61550902
18	*	.	83.56341367	82.24689485
			.	84.87993250
19	*	.	81.44033301	80.40112841
			.	82.47953762
20	*	.	87.17310317	85.74463702
			.	88.60156931
21	*	.	80.22305829	78.86500505
			.	81.58111153

95% Confidence Interval for Predicted Value

Dependent Variable: MCR   MC Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	81.70468820	80.30468678
			.	83.10468962
17	*	.	86.39390852	84.87902164
			.	87.90879540
18	*	.	83.56341367	81.93082012
			.	85.19600723
19	*	.	81.44033301	80.15163231
			.	82.72903372
20	*	.	87.17310317	85.40168557
			.	88.94452076
21	*	.	80.22305829	78.53895859
			.	81.90715800

99% Confidence Interval for Predicted Value

Dependent Variable: MCR   MC Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	81.70468820	79.66763959
			.	83.74173681
17	*	.	86.39390852	84.18969775
			.	88.59811929
18	*	.	83.56341367	81.18793578
			.	85.93889156
19	*	.	81.44033301	79.56523065
			.	83.31543537
20	*	.	87.17310317	84.59563168
			.	89.75057466
21	*	.	80.22305829	77.77263724
			.	82.67347935

90% Confidence Interval for Predicted Value

Dependent Variable: TNS   TNMCS Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	11.46882022	10.44315319
			.	12.49448724
17	*	.	9.48259121	8.23717412
			.	10.72800831
18	*	.	11.99177931	10.73469816
			.	13.24886045
19	*	.	13.03599145	11.75793474
			.	14.31404816
20	*	.	9.96023831	8.48399410
			.	11.43648252
21	*	.	15.53665107	13.95333979
			.	17.11996236

95% Confidence Interval for Predicted Value

Dependent Variable: TNS   TNMCS Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	11.46882022	10.20310113
			.	12.73453930
17	*	.	9.48259121	7.94569069
			.	11.01949174
18	*	.	11.99177931	10.44048481
			.	13.54307380
19	*	.	13.03599145	11.45881218
			.	14.61317072
20	*	.	9.96023831	8.13848677
			.	11.78198984
21	*	.	15.53665107	13.58277397
			.	17.49052818

99% Confidence Interval for Predicted Value

Dependent Variable: TNS   TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	11.46882022	9.65051054
			.	13.28712990
17	*	.	9.48259121	7.27470707
			.	11.69047536
18	*	.	11.99177931	9.76321704
			.	14.22034157
19	*	.	13.03599145	10.77024357
			.	15.30173933
20	*	.	9.96023831	7.34314224
			.	12.57733438
21	*	.	15.53665107	12.72974574
			.	18.34355640

90% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	12.55183119 .	11.47154507 13.63211731
17	*	.	10.38237178 .	9.19299458 11.57174898
18	*	.	11.31203777 .	9.98076129 12.64331424
19	*	.	12.40133749 .	11.32622394 13.47645104
20	*	.	9.85084428 .	8.53203495 11.16965362
21	*	.	12.54401458 .	11.34367340 13.74435577

95% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	12.55183119 .	11.22379656 13.87986583
17	*	.	10.38237178 .	8.92022755 11.84451601
18	*	.	11.31203777 .	9.67545166 12.94862388
19	*	.	12.40133749 .	11.07966169 13.72301330
20	*	.	9.85084428 .	8.22958447 11.47210410
21	*	.	12.54401458 .	11.06839193 14.01963723

99% Confidence Interval for Predicted Value

Dependent Variable: TNM   TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	12.55183119	10.66287859
			.	14.44078379
17	*	.	10.38237178	8.30266612
			.	12.46207743
18	*	.	11.31203777	8.98421174
			.	13.63986379
19	*	.	12.40133749	10.52142948
			.	14.28124550
20	*	.	9.85084428	7.54481788
			.	12.15687069
21	*	.	12.54401458	10.44513767
			.	14.64289150

2. KC-135R

90% Confidence Interval for Predicted Value

Dependent Variable: MCR   MC Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	86.04120939	84.46647786
			.	87.61594093
17	*	.	89.40876768	87.03597138
			.	91.78156399
18	*	.	82.24157287	79.79810823
			.	84.68503752
19	*	.	80.99066772	78.50682053
			.	83.47451490
20	*	.	83.44066643	80.90929953
			.	85.97203333
21	*	.	81.93191489	79.09441519
			.	84.76941459

95% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	86.04120939 .	84.10533520 87.97708358
17	*	.	89.40876768 .	86.49180373 92.32573164
18	*	.	82.24157287 .	79.23773379 85.24541196
19	*	.	80.99066772 .	77.93718492 84.04415051
20	*	.	83.44066643 .	80.32876594 86.55256692
21	*	.	81.93191489 .	78.44367432 85.42015546

99% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	86.04120939 .	83.28768589 88.79473289
17	*	.	89.40876768 .	85.25977451 93.55776085
18	*	.	82.24157287 .	77.96901138 86.51413437
19	*	.	80.99066772 .	76.64749465 85.33384078
20	*	.	83.44066643 .	79.01440196 87.86693090
21	*	.	81.93191489 .	76.97035673 86.89347305

90% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	8.75735582 .	7.53587521 9.97883643
17	*	.	7.28352165 .	5.96745964 8.59958366
18	*	.	10.10761821 .	9.15877152 11.05646490
19	*		9.74168623 .	8.74885860 10.73451387
20	*	.	10.08518732 .	7.43121083 12.73916380
21	*	.	8.87627719 .	7.08842016 10.66413422

95% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	8.75735582 .	7.24999399 10.26471765
17	*	.	7.28352165 .	5.65944213 8.90760117
18	*	.	10.10761821 .	8.93669886 11.27853757
19	*	.	9.74168623 .	8.51649243 10.96688004
20	*	.	10.08518732 .	6.81006136 13.36031327
21	*	.	8.87627719 .	6.66998147 11.08257291

99% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	8.75735582 .	6.59190644 10.92280519
17	*	.	7.28352165 .	4.95039770 9.61664559
18	*	.	10.10761821 .	8.42549615 11.78974027
19	*	.	9.74168623 .	7.98159445 11.50177802
20	*	.	10.08518732 .	5.38019923 14.79017540
21	*	.	8.87627719 .	5.70675173 12.04580265

90% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	9.66367097 .	7.71620267 11.61113928
17	*	.	7.76615507 .	4.83172117 10.70058898
18	*	.	12.51151270 .	9.48968336 15.53334204
19	*	.	13.91588367 .	10.84411330 16.98765404
20	*	.	12.10504047 .	8.97450253 15.23557841
21	*	.	13.77552068 .	10.26638874 17.28465262

95% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	9.66367097	7.26957805
			.	12.05776390
17	*	.	7.76615507	4.15874979
			.	11.37356035
18	*	.	12.51151270	8.79666907
			.	16.22635634
19	*	.	13.91588367	10.13964573
			.	17.69212161
20	*	.	12.10504047	8.25655744
			.	15.95352349
21	*	.	13.77552068	9.46161841
			.	18.08942295

99% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	9.66367097	6.25839228
			.	13.06894967
17	*	.	7.76615507	2.63510096
			.	12.89720918
18	*	.	12.51151270	7.22764183
			.	17.79538358
19	*	.	13.91588367	8.54468756
			.	19.28707978
20	*	.	12.10504047	6.63108534
			.	17.57899560
21	*	.	13.77552068	7.63956858
			.	19.91147278

3. RC-135V/W

90% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	49.94728562 .	31.17520201 68.71936922
17	*	.	61.68446486 .	48.61089499 74.75803473
18	*	.	52.72501737 .	35.63085401 69.81918072
19	*	.	64.11876795 .	51.58207159 76.65546431
20	*	.	66.05812975 .	53.72572010 78.39053941
21	*	.	67.92678566 .	55.59306896 80.26050236

95% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	49.94728562 .	27.04727605 72.84729519
17	*	.	61.68446486 .	45.73605543 77.63287429
18	*	.	52.72501737 .	31.87189777 73.57813696
19	*	.	64.11876795 .	48.82528894 79.41224697
20	*	.	66.05812975 .	51.01385949 81.10240002
21	*	.	67.92678566 .	52.88092093 82.97265038

99% Confidence Interval for Predicted Value

Dependent Variable: MCR   MC Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	49.94728562 .	18.01696792 81.87760331
17	*	.	51.68446486 .	39.44701652 83.92191319
18	*	.	52.72501737 .	23.64875295 81.80128178
19	*	.	64.11876795 .	42.79451296 85.44302295
20	*	.	66.05812975 .	45.08135560 87.03490391
21	*	.	67.92678566 .	46.94778829 88.90578303

90% Confidence Interval for Predicted Value

Dependent Variable: TNS   TNMCS Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	34.88564468 .	21.69661402 48.07467535
17	*	.	25.64994886 .	15.31865653 35.98124118
18	*	.	33.53656886 .	21.07241089 46.00072682
19	*	.	18.75376636 .	9.93657858 27.57095414
20	*	.	17.80203681 .	8.79492072 26.80915291
21	*	.	14.03074233 .	5.26834732 22.79313735

95% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	34.88564468	18.72165444
			.	51.04963493
17	*	.	25.64994886	12.98829748
			.	38.31160024
18	*	.	33.53656886	18.26095589
			.	48.81218182
19	*	.	18.75376636	7.94774575
			.	29.55978697
20	*	.	17.80203681	6.76324706
			.	28.84082657
21	*	.	14.03074233	3.29187371
			.	24.76961096

99% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	34.88564468	12.07683662
			.	57.69445275
17	*	.	25.64994886	7.78324814
			.	43.51664958
18	*	.	33.53656886	11.98133906
			.	55.09179865
19	*	.	18.75376636	3.50552342
			.	34.00200930
20	*	.	17.80203681	2.22533620
			.	33.37873743
21	*	.	14.03074233	-1.12274326
			.	29.18422792

90% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	25.48874578 .	19.55616767 31.42132389
17	*	.	23.97358490 .	17.91792950 30.02924031
18	*	.	35.50927994 .	27.15490431 43.86365556
19	*	.	24.38095326 .	18.37253517 30.38937135
20	*	.	24.14193611 .	18.10703663 30.17683559
21	*	.	24.72389091 .	18.74726254 30.70051927

95% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	25.48874578 .	18.25161120 32.72588037
17	*	.	23.97358490 .	16.58630869 31.36086112
18	*	.	35.50927994 .	25.31780169 45.70075819
19	*	.	24.38095326 .	17.05130171 31.71060481
20	*	.	24.14193611 .	16.77997999 31.50389223
21	*	.	24.72389091 .	17.43301955 32.01476227

99% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	25.48874578	15.39774535
			.	35.57974621
17	*	.	23.97358490	13.67323652
			.	34.27393328
18	*	.	35.50927994	21.29893049
			.	49.71962938
19	*	.	24.38095326	14.16095305
			.	34.60095347
20	*	.	24.14193611	13.87689246
			.	34.40697976
21	*	.	24.72389091	14.55796333
			.	34.88981848

4. EC-135A/C/G/L/N/Y

90% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	55.60915601	46.17084371
			.	65.04746832
17	*	.	69.76061420	62.70528198
			.	76.81594643
18	*	.	63.29438279	54.80743894
			.	71.78132665
19	*	.	56.53393801	47.62100889
			.	65.44686713
20	*	.	36.31416436	16.12601618
			.	56.50231253
21	*	.	12.98666918	-25.13924381
			.	51.11258216

95% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	55.60915601	44.00629879
			.	67.21201323
17	*	.	69.76061420	61.08724022
			.	78.43398819
18	*	.	63.29438279	52.86107707
			.	73.72768851
19	*	.	56.53393801	45.57695326
			.	67.49092275
20	*	.	36.31416436	11.49614677
			.	61.13218194
21	*	.	12.98666918	-33.88288870
			.	59.85622705

99% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	55.60915601	39.10563517
			.	72.11267686
17	*	.	69.76061420	57.42389354
			.	82.09733486
18	*	.	63.29438279	48.45439337
			.	78.13437221
19	*	.	56.53393801	40.94908484
			.	72.11879118
20	*	.	36.31416436	1.01383594
			.	71.61449277
21	*	.	12.98666918	-53.67904173
			.	79.65238008

90% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	30.42982955	24.68317809
			.	36.17648102
17	*	.	22.39999377	17.86730641
			.	26.93268113
18	*	.	15.22100151	10.80934476
			.	19.63265825
19	*	.	19.10297510	14.75933795
			.	23.44661225
20	*	.	15.96548959	11.59136256
			.	20.33961663
21	*	.	13.09389269	8.51476907
			.	17.67301631

95% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	30.42982955	23.41950633
			.	37.44015277
17	*	.	22.39999377	16.87058179
			.	27.92940575
18	*	.	15.22100151	9.83923442
			.	20.60276859
19	*	.	19.10297510	13.80418491
			.	24.40176529
20	*	.	15.96548959	10.62950489
			.	21.30147429
21	*	.	13.09389269	7.50783326
			.	18.67995212

99% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	30.42982955	20.65508047
			.	40.20457863
17	*	.	22.39999377	14.69013318
			.	30.10985435
18	*	.	15.22100151	7.71700758
			.	22.72499544
19	*	.	19.10297510	11.71467889
			.	26.49127131
20	*	.	15.96548959	8.52533171
			.	23.40564747
21	*	.	13.09389269	5.30504650
			.	20.88273888

90% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	31.04981465	20.32457053
			.	41.77505877
17	*	.	24.03754031	16.96113005
			.	31.11395056
18	*	.	21.06023098	15.09668683
			.	27.02377513
19	*	.	25.99440178	19.10951753
			.	32.87928604
20	*	.	28.72719213	17.47127400
			.	39.98311025
21	*	.	28.07328079	14.39349207
			.	41.75306951

95% Confidence Interval for Predicted Value

Dependent Variable: TNM   TNMCM Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	31.04981465 .	17.93848920 44.16114010
17	*	.	24.03754031 .	15.38681713 32.68826348
18	*	.	21.06023098 .	13.76995700 28.35050496
19	*	.	25.99440178 .	17.57781405 34.41098952
20	*	.	28.72719213 .	14.96713183 42.48725243
21	*	.	28.07328079 .	11.35010321 44.79645837

99% Confidence Interval for Predicted Value

Dependent Variable: TNM   TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	31.04981465 .	12.66872206 49.43090724
17	*	.	24.03754031 .	11.90987676 36.16520385
18	*	.	21.06023098 .	10.83981493 31.28064703
19	*	.	25.99440178 .	14.19497852 37.79382505
20	*	.	28.72719213 .	9.43662205 48.01776221
21	*	.	28.07328079 .	4.62864305 51.51791854

5. E-4B

90% Confidence Interval for Predicted Value

Dependent Variable: MCR   MC Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	93.05346347	79.00492271
			.	107.10200424
17	*	.	68.63419172	55.15216211
			.	82.11622133
18	*	.	63.77931732	49.58469765
			.	77.97393700
19	*	.	80.75276338	66.00254933
			.	95.50297744
20	*	.	74.39834795	61.57003831
			.	87.22665758
21	*	.	82.95107811	69.40955687
			.	96.49259935

95% Confidence Interval for Predicted Value

Dependent Variable: MCR   MC Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	93.05346347	75.78308638
			.	110.32384056
17	*	.	68.63419172	52.06024719
			.	85.20813626
18	*	.	63.77931732	46.32936016
			.	81.22927448
19	*	.	80.75276338	62.61979405
			.	98.88573272
20	*	.	74.39834795	58.62804493
			.	90.16865097
21	*	.	82.95107811	66.30399838
			.	99.59815784

99% Confidence Interval for Predicted Value

Dependent Variable: MCR   MC Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	93.05346347 .	68.48864958 117.61827737
17	*	.	68.63419172 .	45.05996049 92.20842295
18	*	.	63.77931732 .	38.95907467 88.59955998
19	*	.	80.75276338 .	54.96102677 106.54449999
20	*	.	74.39834795 .	51.96718986 96.82950603
21	*	.	82.95107811 .	59.27282179 106.62933442

90% Confidence Interval for Predicted Value

Dependent Variable: TNS   TNMCS Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	2.44575589 .	-10.87108347 15.76259524
17	*	.	2.54887063 .	-10.75885583 15.85659710
18	*	.	3.83345749 .	-9.59688714 17.26380212
19	*	.	3.83080783 .	-9.24588690 16.90750256
20	*	.	3.95096260 .	-9.05527709 16.95720230
21	*	.	-2.22649146 .	-16.65679140 12.20380848

95% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	2.44575589	-13.83372575
			.	18.72523753
17	*	.	2.54887063	-13.71947074
			.	18.81721201
18	*	.	3.83345749	-12.58478133
			.	20.25169631
19	*	.	3.83080783	-12.15510340
			.	19.81671907
20	*	.	3.95096260	-11.94881922
			.	19.85074443
21	*	.	-2.22649146	-19.86714903
			.	15.41416611

99% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	2.44575589	-20.37685350
			.	25.26836528
17	*	.	2.54887063	-20.25812095
			.	25.35586221
18	*	.	3.83345749	-19.18367903
			.	26.85059401
19	*	.	3.83080783	-18.58023792
			.	26.24185358
20	*	.	3.95096260	-18.33933619
			.	26.24126140
21	*	.	-2.22649146	-26.95736717
			.	22.50438425

90% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	7.94167694 .	-8.46928868 24.35264257
17	*	.	20.02982736 .	2.31034741 37.74930731
18	*	.	25.80018913 .	11.71236817 39.88801009
19	*	.	17.66477244 .	2.74165996 32.58788492
20	*	.	22.34768317 .	8.36680443 36.32856192
21	*	.	17.28153114 .	2.44173363 32.12132866

95% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	7.94167694 .	-12.12029170 28.00364559
17	*	.	20.02982736 .	-1.63176522 41.69141994
18	*	.	25.80018913 .	8.57820300 43.02217527
19	*	.	17.66477244 .	-0.57833535 35.90788023
20	*	.	22.34768317 .	5.25643105 39.43893530
21	*	.	17.28153114 .	-0.85972631 35.42278860

99% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	7.94167694	-20.18369486
			.	36.06704875
17	*	.	20.02982736	-10.33809695
			.	50.39775167
18	*	.	25.80018913	1.65625930
			.	49.94411897
19	*	.	17.66477244	-7.91069318
			.	43.24023806
20	*	.	22.34768317	-1.61296741
			.	46.30833375
21	*	.	17.28153114	-8.15114798
			.	42.71421026

6. B-1B

90% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	51.48271236	47.49753334
			.	55.46789139
17	*	.	49.52682879	45.04983276
			.	54.00382482
18	*	.	55.47081693	50.64209789
			.	60.29953596
19	*	.	52.20957353	48.04676839
			.	56.37237868
20	*	.	53.54942588	49.37453477
			.	57.72431699
21	*	.	53.91533029	48.38691238
			.	59.44374819

95% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	51.48271236	46.58358827
			.	56.38183646
17	*	.	49.52682879	44.02309634
			.	55.03056124
18	*	.	55.47081693	49.53469872
			.	61.40693513
19	*	.	52.20957353	47.09208725
			.	57.32705981
20	*	.	53.54942588	48.41708189
			.	58.68176988
21	*	.	53.91533029	47.11904706
			.	60.71161352

99% Confidence Interval for Predicted Value

Dependent Variable: MCR MC Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	51.48271236	44.51436008
			.	58.45106465
17	*	.	49.52682879	41.69850155
			.	57.35515603
18	*	.	55.47081693	47.02747848
			.	63.91415538
19	*	.	52.20957353	44.93063009
			.	59.48851698
20	*	.	53.54942588	46.24934932
			.	60.84950245
21	*	.	53.91533029	44.24852152
			.	63.58213905

90% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 90% CLI
16	*	.	36.61511845	33.07691900
			.	40.15331790
17	*	.	36.10597830	32.78285977
			.	39.42909682
18	*	.	36.02285337	32.72710729
			.	39.31859946
19	*	.	37.62300814	33.46413113
			.	41.78188515
20	*	.	35.93972845	32.66901856
			.	39.21043834
21	*	.	35.51371322	32.33278674
			.	38.69463970

95% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	36.61511845	32.29887935
			.	40.93135755
17	*	.	36.10597830	32.05211578
			.	40.15984081
18	*	.	36.02285337	32.00238242
			.	40.04332432
19	*	.	37.62300814	32.54960630
			.	42.69640997
20	*	.	35.93972845	31.94979908
			.	39.92965782
21	*	.	35.51371322	31.63331036
			.	39.39411608

99% Confidence Interval for Predicted Value

Dependent Variable: TNS   TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	36.61511845 .	30.59682901 42.63340789
17	*	.	36.10597830 .	30.45353009 41.75842650
18	*	.	36.02285337 .	30.41696424 41.62874250
19	*	.	37.62300814 .	30.54897912 44.69703716
20	*	.	35.93972845 .	30.37642456 41.50303234
21	*	.	35.51371322 .	30.10312613 40.92430031

90% Confidence Interval for Predicted Value

Dependent Variable: TNM   TNMCM Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	27.26249550 .	20.72407828 33.80091272
17	*	.	28.81343176 .	22.46075032 35.16611321
18	*	.	26.35018005 .	19.60230409 33.09805601
19	*	.	27.80988477 .	21.36241617 34.25735336
20	*	.	28.63096867 .	22.26814488 34.99379246
21	*	.	25.34663306 .	18.29177579 32.40149032

95% Confidence Interval for Predicted Value

Dependent Variable: TNM   TNMCM Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	27.26249550	19.28629957
			.	35.23869143
17	*	.	28.81343176	21.06381435
			.	36.56304917
18	*	.	26.35018005	18.11846601
			.	34.58189409
19	*	.	27.80988477	19.94463680
			.	35.67513274
20	*	.	28.63096867	20.86897864
			.	36.39295870
21	*	.	25.34663306	16.74043343
			.	33.95283268

99% Confidence Interval for Predicted Value

Dependent Variable: TNM   TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	27.26249550	16.14099490
			.	38.38399609
17	*	.	28.81343176	18.00785786
			.	39.61900567
18	*	.	26.35018005	14.87240125
			.	37.82795885
19	*	.	27.80988477	16.84308295
			.	38.77668658
20	*	.	28.63096867	17.80814317
			.	39.45379417
21	*	.	25.34663306	13.34669536
			.	37.34657076

7. B-52H

90% Confidence Interval for Predicted Value

Dependent Variable: MCR   Mission Capable Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	79.13342130	76.02633565
			.	82.24050695
17	*	.	79.25934310	76.11762669
			.	82.40105950
18	*	.	80.77040461	77.08421540
			.	84.45659381
19	*	.	79.13342130	76.02633565
			.	82.24050695
20	*	.	75.58242675	72.50548289
			.	78.65937060
21	*	.	79.10823694	76.00784577
			.	82.20862811

95% Confidence Interval for Predicted Value

Dependent Variable: MCR   Mission Capable Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	79.13342130	75.34309666
			.	82.92374595
17	*	.	79.25934310	75.42677250
			.	83.09191369
18	*	.	80.77040461	76.27363324
			.	85.26717598
19	*	.	79.13342130	75.34309666
			.	82.92374595
20	*	.	75.58242675	71.82887199
			.	79.33598151
21	*	.	79.10823694	75.32607887
			.	82.89039501

99% Confidence Interval for Predicted Value

Dependent Variable: MCR   Mission Capable Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	79.13342130	73.84843355
			.	84.41840905
17	*	.	79.25934310	73.91545028
			.	84.60323592
18	*	.	80.77040461	74.50039245
			.	87.04041677
19	*	.	79.13342130	73.84843355
			.	84.41840905
20	*	.	75.58242675	70.34870858
			.	80.81614491
21	*	.	79.10823694	73.83463615
			.	84.38183774

90% Confidence Interval for Predicted Value

Dependent Variable: TNS   TNMCS Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	9.24041082	5.65657402
			.	12.82424762
17	*	.	10.49180214	6.96706188
			.	14.01654240
18	*	.	9.20030031	5.32034342
			.	13.08025720
19	*	.	11.32374499	8.06054356
			.	14.58694642
20	*	.	15.98523995	12.75502725
			.	19.21545265
21	*	.	14.84510257	10.79453452
			.	18.89567061

95% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	9.24041082	4.84819243
			.	13.63262921
17	*	.	10.49180214	6.17201029
			.	14.81159399
18	*	.	9.20030031	4.44516804
			.	13.95543258
19	*	.	11.32374499	7.32448550
			.	15.32300448
20	*	.	15.98523995	12.02641023
			.	19.94406967
21	*	.	14.84510257	9.88087555
			.	19.80932959

99% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	9.24041082	3.04260540
			.	15.43821623
17	*	.	10.49180214	4.39619692
			.	16.58740736
18	*	.	9.20030031	2.49039158
			.	15.91020904
19	*	.	11.32374499	5.68043906
			.	16.96705092
20	*	.	15.98523995	10.39898396
			.	21.57149594
21	*	.	14.84510257	7.84014280
			.	21.85006233

90% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	17.06825865	14.37253777
			.	19.76397953
17	*	.	17.39659243	14.73911771
			.	20.05406715
18	*	.	17.50603703	14.85139873
			.	20.16067533
19	*	.	17.17770325	14.49963021
			.	19.85577628
20	*	.	17.94381540	15.25072610
			.	20.63690470
21	*	.	16.63048028	13.81762592
			.	19.44333464

95% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	17.06825865	13.77975668
			.	20.35676062
17	*	.	17.39659243	14.15474684
			.	20.63843803
18	*	.	17.50603703	14.26765157
			.	20.74442248
19	*	.	17.17770325	13.91072983
			.	20.44467666
20	*	.	17.94381540	14.65852368
			.	21.22910712
21	*	.	16.63048028	13.19908752
			.	20.06187304

99% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	17.06825865 .	12.48298054 21.65353676
17	*	.	17.39659243 .	12.87636901 21.91681586
18	*	.	17.50603703 .	12.99063820 22.02143585
19	*	.	17.17770325 .	12.62244319 21.73296331
20	*	.	17.94381540 .	13.36301346 22.52461734
21	*	.	16.63048028 .	11.84596433 21.41499622

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90% Confidence Interval for Predicted Value

Dependent Variable: MCR Mission Capable Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	79.49904968 .	76.80741597 82.19068339
17	*	.	78.43921008 .	75.90937863 80.96904153
18	*	.	80.15681526 .	77.47003289 82.84359763
19	*	.	78.19115383 .	75.26481466 81.11749299
20	*	.	75.72786534 .	73.10146388 78.35426680
21	*	.	75.69826328 .	72.92162233 78.47490423

95% Confidence Interval for Predicted Value

Dependent Variable: MCR   Mission Capable Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	79.49904968	76.20859912
			.	82.78950024
17	*	.	78.43921008	75.34655848
			.	81.53186169
18	*	.	80.15681526	76.87229532
			.	83.44133520
19	*	.	78.19115383	74.61378209
			.	81.76852556
20	*	.	75.72786534	72.51715946
			.	78.93857121
21	*	.	75.69826328	72.30389363
			.	79.09263293

99% Confidence Interval for Predicted Value

Dependent Variable: MCR   Mission Capable Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	79.49904968	74.88608537
			.	84.11201400
17	*	.	78.43921008	74.10354503
			.	82.77487513
18	*	.	80.15681526	75.55216524
			.	84.76146528
19	*	.	78.19115383	73.17594759
			.	83.20636006
20	*	.	75.72786534	71.22669708
			.	80.22903360
21	*	.	75.69826328	70.93961221
			.	80.45691435

90% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	11.16582477 .	8.24730746 14.08434208
17	*	.	11.83509071 .	8.97197327 14.69820815
18	*	.	10.75948474 .	7.78262085 13.73634862
19	*	.	10.09021880 .	6.97983107 13.20060653
20	*	.	10.35314470 .	7.30049762 13.40579178
21	*	.	11.76338365 .	8.89683484 14.62993245

95% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	11.16582477 .	7.60553409 14.72611546
17	*	.	11.83509071 .	8.34238217 15.32779926
18	*	.	10.75948474 .	7.12801724 14.39095223
19	*	.	10.09021880 .	6.29586595 13.88457164
20	*	.	10.35314470 .	6.62922950 14.07705990
21	*	.	11.76338365 .	8.26648919 15.26027810

99% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	11.16582477 .	6.20158176 16.13006779
17	*	.	11.83509071 .	6.96507994 16.70510149
18	*	.	10.75948474 .	5.69599730 15.82297218
19	*	.	10.09021880 .	4.79961438 15.38082321
20	*	.	10.35314470 .	5.16075406 15.54553534
21	*	.	11.76338365 .	6.88753630 16.63923099

90% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	15.33880992 .	14.13863313 16.53898671
17	*	.	16.39603004 .	15.24956151 17.54249856
18	*	.	14.73737089 .	13.54011470 15.93462707
19	*	.	14.92945346 .	13.70188197 16.15702495
20	*	.	16.17047362 .	15.02451565 17.31643159
21	*	.	15.25869799 .	13.95183770 16.56555828

95% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	15.33880992 .	13.86791745 16.80970239
17	*	.	16.39603004 .	14.99096043 17.80109964
18	*	.	14.73737089 .	13.27005779 16.20468398
19	*	.	14.92945346 .	13.42498705 16.43391986
20	*	.	16.17047362 .	14.76602974 17.57491750
21	*	.	15.25869799 .	13.65705814 16.86033783

99% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	15.33880992 .	13.26325162 17.41436822
17	*	.	16.39603004 .	14.41335358 18.37870649
18	*	.	14.73737089 .	12.66686341 16.80787836
19	*	.	14.92945346 .	12.80651940 17.05238752
20	*	.	16.17047362 .	14.18868011 18.15226713
21	*	.	15.25869799 .	12.99864368 17.51875230

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90% Confidence Interval for Predicted Value

Dependent Variable: MCR   Mission Capable Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	75.92908604	73.53479741
			.	78.32337467
17	*	.	78.20976593	75.60845606
			.	80.81107580
18	*	.	80.08512190	77.51607391
			.	82.65416988
19	*	.	77.97872816	74.56351148
			.	81.39394484
20	*	.	81.97122579	75.17481909
			.	88.76763249
21	*	.	77.34642978	66.96278345
			.	87.73007611

95% Confidence Interval for Predicted Value

Dependent Variable: MCR   Mission Capable Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	75.92908604	72.98570080
			.	78.87247128
17	*	.	78.20976593	75.01188203
			.	81.40764983
18	*	.	80.08512190	76.92689869
			.	83.24334511
19	*	.	77.97872816	73.78027930
			.	82.17717702
20	*	.	81.97122579	73.61615827
			.	90.32629331
21	*	.	77.34642978	64.58143940
			.	90.11142017

99% Confidence Interval for Predicted Value

Dependent Variable: MCR   Mission Capable Rate

Observation		Observed	Predicted / Residual	Lower 99% CLI / Upper 99% CLI
16	*	.	75.92908604	71.74251211
			.	80.11565998
17	*	.	78.20976593	73.66120150
			.	82.75833036
18	*	.	80.08512190	75.59296953
			.	84.57727427
19	*	.	77.97872816	72.00699319
			.	83.95046313
20	*	.	81.97122579	70.08725374
			.	93.85519784
21	*	.	77.34642978	59.18992912
			.	95.50293045

90% Confidence Interval for Predicted Value

Dependent Variable: TNS   TNMCS Rate

Observation		Observed	Predicted / Residual	Lower 90% CLI / Upper 90% CLI
16	*	.	12.02922785	10.10435916
			.	13.95409653
17	*	.	12.85231017	10.79579457
			.	14.90882577
18	*	.	12.33843986	10.40209555
			.	14.27478417
19	*	.	11.97171372	10.04734694
			.	13.89608049
20	*	.	12.08740437	10.15963734
			.	14.01517139
21	*	.	13.54185523	11.28079547
			.	15.80291499

95% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	12.02922785	9.67612712
			.	14.38232858
17	*	.	12.85231017	10.33827459
			.	15.36634575
18	*	.	12.33843986	9.97131048
			.	14.70556924
19	*	.	11.97171372	9.61922656
			.	14.32420087
20	*	.	12.08740437	9.73076050
			.	14.44404824
21	*	.	13.54185523	10.77776986
			.	16.30594060

99% Confidence Interval for Predicted Value

Dependent Variable: TNS TNMCS Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	12.02922785	8.73035753
			.	15.32809817
17	*	.	12.85231017	9.32782129
			.	16.37679905
18	*	.	12.33843986	9.01990243
			.	15.65697729
19	*	.	11.97171372	8.67370358
			.	15.26972385
20	*	.	12.08740437	8.78356683
			.	15.39124191
21	*	.	13.54185523	9.66681534
			.	17.41689512

90% Confidence Interval for Predicted Value

Dependent Variable: TNM   TNMCM Rate

Observation		Observed	Predicted Residual	Lower 90% CLI Upper 90% CLI
16	*	.	12.78501618	9.15790440
			.	16.41212797
17	*	.	11.67424906	7.79211491
			.	15.55638322
18	*	.	11.74764099	7.72010921
			.	15.77517278
19	*	.	13.63738072	9.05065539
			.	18.22410604
20	*	.	3.84448096	-7.79310800
			.	15.48206991
21	*	.	-0.52446749	-16.38844047
			.	15.33950549

95% Confidence Interval for Predicted Value

Dependent Variable: TNM   TNMCM Rate

Observation		Observed	Predicted Residual	Lower 95% CLI Upper 95% CLI
16	*	.	12.78501618	8.28709393
			.	17.28293843
17	*	.	11.67424906	6.86007773
			.	16.48842040
18	*	.	11.74764099	6.75316442
			.	16.74211757
19	*	.	13.63738072	7.94945735
			.	19.32530408
20	*	.	3.84448096	-10.58710357
			.	18.27606548
21	*	.	-0.52446749	-20.19712201
			.	19.14818703

99% Confidence Interval for Predicted Value

Dependent Variable: TNM TNMCM Rate

Observation		Observed	Predicted Residual	Lower 99% CLI Upper 99% CLI
16	*	.	12.78501618	6.24038979
			.	19.32964258
17	*	.	11.67424906	4.66946974
			.	18.67902839
18	*	.	11.74764099	4.48051156
			.	19.01477043
19	*	.	13.63738072	5.36126314
			.	21.91349829
20	*	.	3.84448096	-17.15395426
			.	24.84291617
21	*	.	-0.52446749	-29.14883378
			.	28.09989880

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Vita

Captain Charles R. Jung was born on 1 June 1958 in Berlin, Germany. He graduated from Roseville High School in Roseville, California in 1976 and enlisted in the Air Force as an ASQ-48 Bombing and Navigation Technician in April of that year. Assignments included the 7th Bombardment Wing (Heavy), Carswell AFB, Texas and the 43rd Strategic Wing, Andersen AFB, Guam. In 1984, he graduated from East Texas State University with a Bachelor of Science Degree in Industrial Technology and in 1985, attended Officer Training School. He attended Aircraft Maintenance Officer course at Chanute AFB, Illinios and was assigned to the 92nd Bombardment Wing Fairchild AFB, Washington in September 1985. Duties in the 92 BMW included Avionics Maintenance Squardron Assistant Maintenance Supervisor and Maintenance Supervisor, Officer in Charge Maintenance Standardization and Training Division, Assistant Officer in Charge and Officer in Charge Organizational Maintenance Squadron Bomber Branch under the Readiness Oriented Logistics System (ROLS), and Organizational Maintenance Squadron Assistant Maintenance Supervisor. In 1989, he was assigned to the B-1B System Program Office, Wright-Patterson AFB, Ohio as the Defensive System Support Equipment Program Manager. He was responsible for program management of over $400 million in B-1B defense contracts until entering the School of Systems and Logistics, Air Force Institute of Technology, in May 1990.

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13. ABSTRACT *(Maximum 200 words)* This research analyzed twenty-three maintenance constraints and three production output performance measures for 9 SAC aircraft systems. SAS System for Elementary Statistical Analysis is used to analyze twenty-one months of ex post facto data. Correlation analysis is used to identify maintenance constraints that assist in explaining aircraft maintenance production capability. Forward stepwise regression is used to build predictive models of maintenance production capability for each of the 9 aircraft systems. The twenty-three maintenance constraint measures are regressed against three productivity output measures: Mission Capable Rate, Not Mission Capable Supply Rate and Not Mission Capable Maintenance Rate. The regression models and validation results indicate regression models selection of maintenance constraints is not consistent between aircraft and prediction accuracy is erratic. The findings indicate performance measures may not be generalizable across all aircraft and key performance measures for one aircraft may not be important for another. Production capability assessment based on a few productivity measures generalized across all aircraft types may lead maintenance managers to formulate wrong conclusions about maintenance performance and capability. The validity of these findings is limited by the relatively small number of observations for each aircraft.

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